Biological Rationalism

Steve McKay
Department of Philosophy
McGill University, Montreal

February 2007

A dissertation submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements of the degree of Doctor of Philosophy

Abstract

I argue that contemporary philosophy of language in the analytic tradition rests on two fundamentally wrong assumptions: empiricism and externalism. After I show why these two assumptions are incorrect, I turn my attention to biological rationalism. Biological rationalism—a research program inspired by the work of Noam Chomsky—is committed to nativism and internalism. I believe biological rationalism provides the best framework to achieve a genuine understanding of language. I try to show this by considering the biological rationalist answers to major problems in philosophy of language.

Abrégé

Je soutiens que la philosophie du langage telle qu'élaborée dans la tradition analytique contemporaine repose sur deux hypothèses erronées: l'empirisme et l'externalisme. Après avoir démontré que ces deux hypothèses sont incorrectes, j'examine le rationalisme biologique. Le rationalisme biologique—un programme de recherches inspiré par les travaux de Noam Chomsky—repose sur deux idées directrices: l'innéisme et l'internalisme. Je crois que le rationalisme biologique offre le meilleur cadre afin d'obtenir une compréhension réelle du langage. Je cherche le démontrer en examinant les réponses qu'apporte le rationalisme biologique à certains problèmes majeurs en philosophie du langage.

Acknowledgments

Writing a dissertation is a long endeavor, and I owe the completion of this project to many people who helped me along the way. I would like to thank them here.

Philosophically, my greatest debt goes to Jim McGilvray. I started my graduate studies with no knowledge of Chomsky and the biological rationalist tradition in philosophy of language. My initial attempt to make sense of biological rationalism was not particularly brilliant—it earned me my first B+ in the program. Despite my less than promising start, it slowly became clear to me that this approach to philosophy of language was worth pursuing as a topic for my dissertation. Jim, whether by his teaching, conversations or emails, contributed immensely to my understanding of Chomsky. He was very patient throughout my learning process, and I thank him for that. He also showed much patience waiting for the dissertation. When I think about the time it took me to write this work, my head starts to turn. Jim probably lost hope a few times, but he never let it show. Once I sent him the dissertation, he read it carefully and made an astonishing number of comments. The final product would not be the same without his contribution. Obviously, I am to blame for all the errors that are to be found below.

Other faculty members of the McGill Philosophy Department also provided much needed help. Despite his skepticism towards biological rationalism, David Davies gave me the freedom to explore this avenue fully. He probably disagrees with almost everything below; I hope nonetheless that he will recognize in my work the influence of his rigorous approach to philosophy. Also, I want to thank David for helping me present a paper at the annual Inter-University Conference in Dubrovnik (Croatia). This first experience gave me the confidence to go on and present my work at other venues. Philip Buckley played an important role in my intellectual development. I was wise to follow his advice to go to Leuven; my time there proved extremely enriching philosophically. He worked hard to help me return to McGill after my stay in Belgium. I am grateful for this beyond words. He also wrote too many letters of recommendation to count.

The McGill Philosophy Department is an incredible place to do philosophy. Faculty members must be thanked for that. I have learned enormously about philosophy and teaching in their courses and seminars. This knowledge proves useful everyday when I teach.

Special thanks go to Claudine Lefort and Mylissa Falkner. I could not have completed my Ph.D. without them. God knows I was a real pain in the neck. They helped with letters of recommendation, extensions, more extensions, readmission, paperwork for various jobs, etc. From the bottom of my heart: thank you!

I gratefully acknowledge Jim McGilvray's financial support via various grants he received over the years. The FCAR group on 'concept and nativism' was instrumental in my intellectual development. My research was also supported by a personal FCAR doctoral scholarship. Thanks go to the Champlain College (Lennoxville) that provided financial support via the Professor Development Fund. Cegep de Sherbrooke also contributed financial support. Finally, I want to thank McGill University for an Alma Mater Travel Grant.

My most profound debts are to my family. My parents, Hélène and Patrick McKay, offered their support through my graduate years. In the darkest hours, it helps to know that you are still the 'smartest and brightest' to some. My son, Ulysse, is the most wonderful thing in my life. The fact that he does not care about philosophy whatsoever was a relief on many occasions. Annissa Laplante stood by me during all those years. She suffered my anxieties, bad moods and absences (both physical and mental). Her love and support, more than anything else, made this possible. I dedicate my dissertation to her.

Typographical Conventions

Double quotation marks:

Double quotation marks indicate that a word is mentioned, not used. For instance, "water" refers to the word, not the liquid that comes out of the tap.

Single quotation marks:

An expression between single quotation marks followed by a bibliographical reference is a direct quote. Sentence-length quotes that are not isolated as block quotations are between double quotation marks. An expression between single quotation marks that is not followed by a bibliographical reference is simply emphasized.

Square brackets:

Square brackets are used to refer to the concept expressed by the bracketed word or expression. Thus, [water] refers to the concept of water, not the liquid or the word.

Asterisks:

To avoid using the phonetic alphabet when it is not absolutely necessary, I use the following convention. A word or expression between asterisks refers to the 'sound' fluent speakers make when uttering the word. Hence, *dog* refers to the sound a fluent English speaker makes when uttering "dog".

Italics:

Italics are used to flag the use of new technical terms and sometimes for emphasis.

Number sign:

When the number sign (#) precedes an expression, it indicates that the expression is anomalous (e.g., syntax, semantics).

Introduction

At the origin of this dissertation is my puzzlement about the distinctive trajectories of analytic philosophy of language and biological rationalist science of language since the second half of the 20th century. When I started getting acquainted with the work of contemporary biological rationalists—in particular the research of Noam Chomsky –I was excited to discover that genuine progress was being made towards the creation of a robust theory of language. The 'language organ' theory proposed by biological rationalists offers a solution to the problem of language acquisition –via the theory of Universal Grammar that describes the initial state of the organ—and a cogent description of linguistic competence –via a theory that describes the organ's properties once its development is completed. Some questions obviously remain unanswered and some significant quirks need to be ironed out, but biological rationalism as a theoretical research framework seemed to me the most likely to produce a genuine understanding of language. Given its success and promises, I was surprised to see that many analytic philosophers of language are either very skeptical or totally dismissive of biological rationalism. It is true that many philosophers embrace computationalism, which is a central component of biological rationalism. But biological rationalism's most distinctive and important theoretical hypotheses, nativism and internalism, remain almost universally rejected. Such an attitude strikes me to this day as extremely odd considering the state in which philosophy of language finds itself. On the one hand, you have a research program, biological rationalism, which has generated and empirically supported theories like Universal Grammar in roughly 50 years. On the other, you have analytic philosophy of language which seems bogged down in the same old quandaries and unable to achieve substantial progress. Given the current state of affairs, why are more philosophers not considering biological rationalism as a way to revitalize their own research?

When probed on this issue, analytic philosophers of language usually retort that they are concerned with problems that are essentially different from those biological rationalists seek to solve. I never found this answer satisfactory. The more I read, the more it became clear that philosophers are dealing with the same problems biological rationalists work on. Philosophers try to clarify the nature of linguistic competence and meaning. They also attempt to crack the problem of language acquisition. These are the very questions that biological rationalism and the Language Organ theory aim to answer. The point on which analytic philosophers of language differ from biological rationalists is the set of theoretical assumptions they bring to the table when addressing these issues. Most analytic philosophers of language are committed to empiricism and externalism. My contention is that empiricism and externalism are wrong. The reason why the biological rationalist program has been so successful is precisely because it rejects these two assumptions in favor of a nativist and internalist approach. My goal in this dissertation is to make the most convincing case *for* biological rationalism and *against* empiricism and externalism.

The dissertation is organized in three parts. The first two are expository and critical. In Part 1, I examine the empiricist theory of language acquisition. I do so from two perspectives: philosophy and cognitive sciences. A majority of contemporary analytic philosophers of language defend the empiricist theory of language learning. An empiricist account of the role of environmental evidence and of how children use it to attain linguistic competence has been developed over the years and has become deeply entrenched. I begin by describing this hypothesis. A number of cognitive scientists, especially those working within the connectionist paradigm, have tried to work out how the empiricist theory of language acquisition could be computationally and physically implemented. I spend some time looking at both the theoretical and more concrete properties of the model they present. Once I have completed my exposition of the empiricist position, I assess it both conceptually and empirically. My conclusion is that it fails on both counts. The empiricist hypothesis does not provide a satisfactory explanation of how children acquire language.

Part 2 deals with the externalist dogma that dominates contemporary analytic philosophy of language. Broadly speaking, externalism is the claim that a philosophically cogent theory of language will be built around subject-external properties (i.e., properties 'outside the head') instead of subject-internal properties (i.e., properties 'inside the head'). In the first half of part 2, I describe how externalism shapes how many philosophers understand crucial aspects of language. Then, I argue that the commitment to externalism is fundamentally mistaken. The externalist hypothesis is responsible not only for an inaccurate theory of meaning, but also an erroneous account of language's function, ontology and epistemic properties. As long as philosophers do not reject the externalist paradigm, it is my contention that little progress will be achieved towards a sound theory of language.

Having argued for the elimination of the empiricism and externalism, Part 3 presents biological rationalism as the only viable alternative. At the heart of biological rationalism are two empirical claims. First, language acquisition is possible because substantial innate linguistic resources are available to children. These innate linguistic resources are biologically determined.[1] Environmental evidence plays at best a supporting role in the process of language acquisition. Second, a successful theory of language requires that we adopt an internalist perspective, one that focuses on subject-internal properties. This is true not only for syntax, but also for semantics. After offering what I believe is an empirically informed and conceptually sound account of innateness, I explain how biological rationalism succeeds to provide an account of language acquisition that meets the requirements of descriptive and explanatory adequacy. The last section of Part 3 contains some elements towards an internalist theory of language. I describe how adopting an internalist perspective has positive effects on our understanding of language's function, ontology, semantics and epistemic properties.

[1] We will see below that 'biologically determined' must be understood in a sufficiently broad sense. Biological determination operates via constraints; these include genetic constraints and developmental constraints, but also very general physical constraints that delineate what kind of biological systems are 'physically possible' in the first place. See Chomsky (2005) on these questions.

Part 1

Empiricism and Language Acquisition

In spite of growing evidence of its serious shortcomings, the empiricist theory of language acquisition is still very much alive in philosophy of language today. It is the standard hypothesis offered by most philosophers (e.g., Wittgenstein, Quine, Sellars, Dummett, Putnam, and their heirs) who deign to consider the problem of language acquisition. In fact, some (Quine, 1960, 17; 1990, 37-38; see also 1970, 4-5) go so far as to claim that any other account of language acquisition is inconceivable.[2] The goal of this section is to articulate the case *against* empiricism as an explanation of how linguistic competence is acquired. As I hope to make clear, the facts are damning. Once they are taken into account, it becomes difficult to imagine how someone seeking a sophisticated and empirically grounded philosophy of language could defend such a view.

1 Philosophy and language acquisition

We find two attitudes towards the problem of language acquisition among philosophers. There are those who consider language acquisition to be a

---

[2] In *The Pursuit of Truth* (2004), Quine writes that behaviorism, which is one incarnation of empiricism in psychology and cognitive science, is 'mandatory' and that linguists have 'no choice' but be behaviorists when they seek to explain language acquisition. In an earlier paper entitled 'Philosophical Progress in Language Theory' (1970), Quine defends the same line and states: "But even those who have not embraced behaviorism as a philosophy are obliged to adhere to behavioristic method within certain scientific pursuits; and language theory is such a pursuit. A scientist of language is, insofar, a behaviorist *ex officio*".

relatively simple problem that can be elucidated by doing armchair psychology and philosophical thought experiments. They recognize that philosophers should worry about how language is acquired, but they consider this question to be essentially propaedeutic. It sets the stage for the really substantive philosophical discussions about language that address topics like the 'nature of language', the 'nature of meaning', 'the nature of linguistic knowledge', etc. This is a fair description of the attitude of philosophers like Wittgenstein, Quine, and Putnam towards the problem of language acquisition. Consider, for instance, Quine. In the opening pages of *Word and Object* (1960), he swiftly deals with the question of language acquisition. Language, he claims, is acquired by means of generalization on observable evidence found in the immediate environment of the language learner. He offers no serious *empirical* evidence to support his hypothesis nor does he test it or seriously consider possible alternatives.[3] He takes it to be self-evident that language acquisition (must) proceeds in this fashion. After his short discussion of the question, he moves on to elaborate his substantive theses about language such as the indeterminacy of translation and meaning holism, which depend in no small measure on his assumptions about language acquisition.

The second attitude philosophers have towards the problem of language acquisition is best exemplified by Dummett (1996). He recognizes that the problem of language acquisition is far from trivial. It will be resolved only after serious empirical research by people working in the fields of psychology and

[3] By 'empirical evidence', I mean psycholinguistic data gathered through the observation of actual children learning language.

linguistics. Philosophy has little to say with respect to this issue. But equally, language acquisition theory has little bearing on topics addressed by philosophers of language. Questions like 'What is meaning?' or 'What is it to know a language?' are *philosophical* questions that require *philosophical* answers. Acquisition study, but also psychology and linguistics, are of no help because they approach language from the wrong perspective, namely that of naturalistic sciences. Philosophy of language is "not a description from the outside of the practice of using the language", which is what naturalistic studies of language offer according to Dummett, but a description of language from the standpoint of the speaker herself. What philosophy seeks to do, Dummett claims, is shed some light on the speaker's subjective grasp of what language is (Dummett, 1996, 100). In short, philosophy of language and naturalistic sciences of language may well focus on the same phenomenon, language, but they have distinctive methods and purposes, Dummett contends. If Dummett is right, one can do philosophy of language and remain quite agnostic about *how* language is actually acquired.[4]

Both these attitudes, I believe, are deeply flawed. Their prevalence among philosophers might well be responsible for the dearth of significant progress in the field, at least in contrast to the rapid development of biological rationalist linguistics in the last 50 years. *Contra* Quine, the problem of language acquisition is not simple. It seems simple to many philosophers only because they adopt uncritically the commonsense hypothesis about the process of language acquisition, which proves wholly inadequate upon closer inspection. *Contra*

[4] Dummett does make one substantive claim about the problem of language acquisition; he argues that no speaker ever succeeds in learning her language fully. Language is a public object of which speakers can only have a partial grasp at any given time.

Dummett, the distinction he makes between 'philosophy of language' and 'naturalistic studies of language' should be viewed for what it is: archaic and pernicious. It is the remnant of another age when philosophers believed they could carve out a domain of inquiry that could be isolated from the rest of sciences. While such 'exceptionalism' would be ridiculed in domains like philosophy of physics and philosophy of biology, it is deemed acceptable when it comes to philosophy of language (and philosophy of mind). If philosophers are to avoid falling into complete irrelevance, their work must be informed by the best scientific theories available. Furthermore, a pooling of insights and methods between philosophy and science seems to be the strategy that is most likely to bring us success in the difficult enterprise of understanding language.

Like a small but growing number of philosophers, I think that acquisition study is a component of our understanding of language that we cannot afford to ignore.[5] Indeed, findings about language acquisition are likely to have a profound impact on traditional questions of philosophy of language. For example, if it becomes clear that language acquisition is not learning in the usual sense, this will have considerable repercussions on our theory of language and meaning.

2 The goals of a theory of language acquisition

A theory of language acquisition should provide a cogent and robust explanation of how language learners, in particular children, succeed in becoming competent language users. In addition to the requirements that all naturalistic theories must meet, a successful theory of language acquisition has specific desiderata that it must fulfill.

[5] For example: Chomsky (2002), Laurence and Margolis (2001), Pietroski and Crain (2001).

Desideratum 1: A successful theory must account for the acquisition of all aspects of linguistic competence

While truistic, this desideratum is nonetheless worth belaboring because philosophers rarely respect it. Often, they underestimate or simply do not consider the full range of competence that must be acquired in order for someone to master language. For example, they offer a hypothesis about meaning acquisition but say next to nothing about the acquisition of phonology, morphology, and syntax, all of which are essential components of linguistic competence. Or when they make proposals about, say, the acquisition of syntax, their concept of syntax is so impoverished that it has little to do with the actual syntactic competence that the child masters.[6] In what follows, I offer a rapid overview of the various facets of linguistic competence whose acquisition a cogent theory of language acquisition must explain.

Linguistic competence can be divided into four distinct sub-competences: (1) phonological competence, (2) syntactic competence, (3) morphological competence, and (4) semantic competence. Phonological competence allows speakers to physically realize linguistic utterances through various modalities (e.g., sounds, gestures) and also to recover the syntactic and semantic information from signals (e.g., auditory, visual). For example, our phonological competence allows us to distinguish linguistic signals (e.g., *dog*) from non-linguistic signals (e.g., a cough). To be more specific, consider the case of English phonology. Mature English speakers know, on the basis of phonological features alone, that *blunk* could be an English word but not *bnunk*. They know also that the

[6] For example, the syntax of human language is often compared incorrectly to the syntax of lower functional calculus.

word "pure" rhymes with "your" but not with "mixture". Plurals provide another illustration of the phonological competence that is acquired by all English speakers. The standard plural form for English nouns is obtained by affixing the inflectional morpheme "-s" to nouns. "Car" becomes "cars"; "lollipop" becomes "lollipops"; and "church" becomes "churches". While the same inflectional morpheme (-s) is used in all three cases, it has three distinct phonetic realizations. In "cars", it is realized as /z/; in "lollipops", it is realized as /s/; and in "churches", it is realized as /ɪz/. Mastery of allomorphs is yet another piece of phonological competence that language speakers must acquire.

Syntactic competence enables speakers to generate and parse grammatical sentences. One aspect of syntactic competence is the awareness that sentences are not structureless strings of words, but highly organized units constituted by the rule-governed concatenation of syntactic components (i.e., phrases), which are themselves produced by the concatenation of simpler syntactic elements (i.e., lexical and morphological elements) according to strict guidelines. The guidelines determining how sentences are built are called *syntactic principles*.[7] (1), (2) and (3) are simplified versions of English syntactic principles. Syntactic principles are not always identical across languages. Linguistic diversity is to a large extent the result of the diversity of syntactic principles. (4) is a Japanese syntactic principle, which is the 'opposite' of (3).

[7] My use of 'syntactic principle' at this point is pre-theoretical. In the third part of this dissertation, I will address the question of syntax in a more formal fashion and will adopt a more restricted definition of syntactic principle. Following Chomsky's theoretical vocabulary, all human languages share the same 'syntactic principles' but they differ with respect to settings of 'parameters'.

(1) A sentence has two basic components, (a) Noun phrase, and (b) Verb phrase (e.g., "John ate an apple" where "John" is the noun phrase (NP) and "ate an apple" is the verb phrase (VP).)

(2) A sentence needs an overt subject. (In this case, the subject is "John". "Ate an apple" is not a syntactically correct sentence in English.)

(3) The position of the subject is to the left of the VP. ("ate an apple John" is ungrammatical.)

(4) The position of the subject is to the right of the VP.

These principles require that the speaker distinguishes syntactic categories like VP, NP, but also Adjective Phrase (AP), Tense (T) and many others. This is another element of syntactic competence that must be acquired.

Syntactic competence also provides the speaker with the knowledge to distinguish grammatical and ungrammatical sentences with great accuracy. Given a declarative sentence like (5)

(5) The tree is tall.

an English speaker knows that the following transformations are syntactically acceptable:

(6) Is the tree tall?

(7) What is tall?

(8) How tall is the tree?

She also recognizes automatically that the next transformation is anomalous:

(9) #What the tree is?

Similarly, given a sentence like

(10) The man walks down the street.

sentence (11) is an acceptable expansion of (10) but not (12):

(11) The man with the tall hat walks swiftly down the busy street accompanied by his faithful dog Rex.

(12) #The man walks down with his dog the street.

One last constitutive element of syntactic competence is revealed when we examine the subtle interpretative distinctions that fluent speakers are capable of doing. Pronouns, anaphors and other referring expressions provide an interesting case. In sentence (13), the pronoun "he" refers to John or to any other person. In (14), "he" cannot refer to John; it must necessarily refer to someone else. The anaphor "himself" refers to John in (15), but cannot in (16) despite the apparent structural similarity of (15) and (16).

(13) John likes it when he has good grades.

(14) He likes it when John has good grades.

(15) John said that he thinks he should wash himself.

(16) John said that he thinks Bill should wash himself.[8]

Mature speakers recognize these facts about what a pronoun in a particular syntactic position can be used to refer to, and do so automatically. The same is true for other ambiguities generated by syntactic structure. For instance, sentence (17) is understood as potentially meaning both (18) or (19). (20) and (21) are additional examples of syntactically ambiguous sentences that raise a red flag for average (and attentive) English speakers.

(17) Eating sharks can be dangerous.

---

[8] Sentences (15) and (16) are from Crain, Gualmini and Pietroski (forthcoming).

(18) Sharks that are eating can be dangerous

(19) The consumption of shark meat can be dangerous.

(20) I saw the man with the binoculars.

(21) My son has grown another foot.[9]

Sentences are the structural units by means of which we can express our thoughts. They are built out of words. There are different types of words (e.g., verb, noun, adjective, adverb) that enter in the composition of sentences. Words, like sentences, are structured, and they are the products of morphological generative principles. Affixes (i.e., suffixes, prefixes and infixes) are added to roots, stems and words to create more complex words. (22) and (23) offer some examples of word generation by affixation.

(22) root word = sleep; root + suffix = sleep-y; root+ suffix + suffix = sleep-y-ness.

(23) The present tense of the Italian *credere* ("to believe") is built by affixation on the stem *cred-* (i.e. io cred-o, tu cred-I, egli cred-e, noi cre-iamo, voi cred-ete, essi cred-ono).

Principles governing word composition make up the morphological competence that speakers acquire during their formative years.

Roots, stems, prefixes and suffixes are stored in a mental 'dictionary' called the lexicon. Knowledge of a language involves the acquisition of its lexicon. The acquisition of the lexicon involves learning the syntactic properties, meanings and sounds of each lexical item. According to conservative estimates,

[9] (20) and (21) are from Pinker (1994)

the lexicon of a mature speaker contains several tens of thousands of words (Pinker, 1994; Fodor, 1998; Jackendoff, 2002).

For each element of the lexicon, the child must learn whether it is a noun, verb, preposition, etc. The syntactic category in which a lexical element falls determines its role and its possible interactions with other constituents of the sentence (e.g., agreement, tense). The meaning associated with each lexical item is often rich, full of nuances and versatile. Chomsky (1988, 1997, 2002) provides some interesting examples. Take the verb "persuade". It requires that both subject and object be agents with specific mental attributes. They must be able to express and grasp intentions. To persuade someone entails that we are able to let this person know what we would want her to do, and we assume that this person can actually understand what we would want her to do. Hence, (24) and (25) are semantically anomalous unless understood metaphorically.

(24) #The chair persuades the table.

(25) #The mechanics persuaded the car to start.

The problem with (24) and (25) is that at least one of the elements fails to meet this initial criterion. In addition, the verb "persuade" implies that the subject influences the object by providing reasons. (26) is an anomalous use of "persuade" unless it is understood ironically.

(26) #After revealing her position about social inequities in capitalist society, she persuaded the banker, who had a gun pointed to his head, to hand her the money.

What is amiss in this example is that the person who is ‘persuaded’ is not swayed by the persuader’s reasons (i.e., Marxist argument) but by fear of physical harm (i.e., being shot in the head). Finally, inherent in “persuade” is that once someone is persuaded she will carry out what she was persuaded to do unless there are major obstacles.

There is nothing exceptional with the word “persuade”. It is a staple of the average English speaker’s vocabulary. We can presume that most words in the lexicon have equally subtle semantic properties.[10] In fact, we might speculate that the magnitude of semantic complexity is of an even higher order for abstract concepts like [person], [desire] and [belief].

Desideratum 2: A successful theory must describe the machinery that makes language acquisition possible.

If desideratum 1 focuses on what is acquired, desideratum 2 concerns what the learner must ‘bring to the table’ for successful language acquisition. The only naturalistic way we can explain how the child achieves the state of competent speaker is to posit the existence of cognitive machinery that enables her to bootstrap herself out of the state of non-speaker using the evidence available to her. A theory of language acquisition must identify and describe this cognitive machinery.

We cannot determine *a priori* what cognitive machinery plays a role in language acquisition. This is a strictly empirical issue that can only be resolved by means of naturalistic inquiry. But there are some criteria, both empirical and methodological, by which we can judge a hypothesis’ adequacy. First, the

[10] Chomsky examines many other examples like [house], [chase], [book], [London]. See especially Chomsky (2002) 34-38.

machinery should enable the acquisition of full linguistic competence (i.e., desideratum 1) of (a) *any* natural language on the basis of (b) the evidence that is *actually* available to all children and (c) in a way that is consistent with what is known about the normal timeframe and progression of language acquisition by children. For instance, we know that children typically achieve near adult language competence by the age of 4. A proposal that does not respect this time constraint is clearly inadequate. Likewise, the machinery posited should be cognitively and biologically possible. If a theory of language acquisition requires of the child that she store all past linguistic strings for subsequent analysis, then it cannot be correct because this is incompatible with the limits of human memory. Finally, a complete explanation will provide neurophysiological evidence in support of the existence of the hypothesized mechanism and, if possible, will offer an account of its biological lineage (e.g., adaptation, mutation, etc.) and of the physical constraints that are responsible for its structure.

Additional criteria apply to the description of the machinery. We expect the operations, inputs and outputs of the machinery to be adequately fleshed out. For instance, a theory that relies heavily on abstraction to explain language acquisition must give a substantive explanation of this operation. Similarly, a nativist theory that states that a 'language acquisition device' is responsible for language acquisition must describe the features, the operations, and the representations used by such a device. The detailed description of the acquisition mechanism not only enhances our understanding of the language learning process, it also gives us more opportunities to test the adequacy of the theory.

Desideratum 3: A successful theory must specify what kind of evidence is required for language acquisition to happen.

We know that the child has access to different kinds of input: perceptual, behavioral and linguistic. The first task is to identify what in this input counts as 'signal' and 'noise'. Put differently, some inputs will contribute to language acquisition, while others will be discarded because they are irrelevant. Providing a precise description of the type of evidence necessary for language acquisition is a central requirement of a successful theory of acquisition. In addition, it is necessary to specify *what* the evidence contributes to the learning process and *how* it does so. Nativists argue that the evidence plays essentially a triggering role in language acquisition; it makes available to the child knowledge that had remained latent so far. Others describe the role of evidence in informational terms; the child literally learns new knowledge from the evidence via analysis. Obviously, if the putative evidence put forward by a given theory is insufficient for the acquisition of all aspects of linguistic competence, then the evidential hypothesis of the theory or maybe even the whole theory must be rejected.

As is the case with the study of the learning mechanism, we cannot presume before systematic empirical investigation what will play the role of evidence. We know however that evidence, which is available only to some children, cannot be essential to the process. Since all normal children acquire language, the evidence required for successful acquisition must be available to all of them. This condition on the evidence a theory can rely on is called the *universality* requirement (Cook & Newson, 1996). Furthermore, accessibility does not simply mean that the evidence is present in the immediate environment of the child. This is clearly insufficient. It must be shown that all children can in fact *detect* and *correctly interpret* the evidence. This is the *uptake* requirement. To discover what is the uptake threshold of children, we must examine their perceptual and cognitive systems. Armchair psychology will not suffice in this context.

3 Empiricism and language acquisition

In this section, I offer a comprehensive description of the empiricist theory of language acquisition. My aim at this point is not critical but expository. In my attempt to take empiricism seriously, I might be perceived as being overly charitable. I think this is the case. I allow empiricists to get away with a fair share of conceptual vagueness, question begging and factual errors in this section. But my generosity is only momentary and it is driven by methodological considerations. I find it easier to describe empiricism in the best possible light if I 'hold my punches' at first. I will not exhibit the same restraint in section 4 where my goal is to examine the many problems of the empiricist account of language acquisition.

The empiricist theory of language acquisition is continuous with the venerable empiricist tradition's views on learning. The roots of empiricism as a theory of learning go back to at least Aristotle. In his discussion of sciences, Aristotle lays out some of empiricism's foundational principles.[11] However, it is Berkeley, Locke, and Hume who develop empiricism into a systematic philosophical doctrine that suggests answers to many of philosophy's most difficult problems. To this day, their version of empiricism is considered the

[11] See Aristotle's *Posterior Analytics* (II, 19.99 and onward).

doctrine's *locus classicus*. More recently, behaviorism and connectionism have recycled the assumptions of 18th century empiricism. Given the close connections of contemporary analytic philosophy with behaviorism and its progeny, empiricism still has a very strong influence in philosophy. While contemporary empiricism does differ from what Berkeley, Locke and Hume advocated on some key points, contemporary analytic philosophers and many cognitive scientists have adopted certain components of the classical doctrine with little modifications. This is the case of the empiricist theory of learning, and more specifically the empiricist theory of language acquisition.

3.1 Classical empiricism

Before turning our attention to the details of the contemporary empiricist theory of language acquisition, I want to say a few words about classical empiricism generally in order to set the stage. My survey will be neither historically or theoretically exhaustive (viz., I will say next nothing about epistemology). What I aim to do is highlight only those elements of classical empiricism that are relevant to understand the genesis of the contemporary empiricist theory of language acquisition.

The theoretical nexus of classical empiricism is the idea that sensory experiences are the building blocks of our cognitive life. Once this hypothesis is accepted, classical empiricists believe it becomes possible to solve enduring philosophical problems like:

(a) the nature of mind, mental states, and concepts

(b) concept acquisition

(c) the nature of linguistic meaning

(d) the nature of knowledge

Under the label 'sensory experience', classical empiricists include particular instances of seeing, smelling, hearing, tasting, and tactile feelings. Locke (1975, Book I) adds to the list the alleged impressions caused by our mental activity (e.g., thinking, doubting, emotions).

Classical empiricists argue that mental states such as perceptions, thoughts and beliefs are either impressions resulting from sensory experiences or the products of mental operations on sensory impressions. These operations are described as

- association (e.g., the sensation of red is concatenated with the sensation of triangle, which produces the idea of red triangle);
- decomposition (e.g., the sensation caused by green grass is decomposed into the ideas of green and of grass);
- detection of certain patterns (e.g., similarity, temporal succession).

Hume contends that the mind is capable "of compounding, transposing, augmenting, or diminishing the materials afforded us by the senses and experience".[12] The mind is also able to recognize 'constancy', 'coherence', 'similarity', 'contiguity' and 'cause and effect' (Hume, 1978).

The mental operations that produce mental states are primitive and thought to be self-explanatory by classical empiricists. Hence, few attempts to clarify

[12] Hume, 1981, Section II. See also Hume, 1978, Book I, Section IV. Hume (1981) talks of these as being the 'secret springs and principles' of the mind.

their etiology and their internal operations are offered.[13] Second, these operations are limited in number. Third, these operations can process all types of sense impressions and mental states; they are domain-general operations. Lastly, their action limits itself to highlighting features already present in impressions, or to the production of mental states that are the results of simple 'mechanical' operations on the initial impressions.

Because all mental states are based on sensory impressions, either directly or indirectly, a person's mental life (i.e., concepts, thoughts, etc.) is always a function of her sensory experiences.[14] In the case where no sensory impression has been experienced, the mental life is essentially empty. Newborn infants find themselves in this situation according to classical empiricists. At the initial stage of her development, an infant's mind is still, to borrow Locke's dated expression, a *tabula rasa*. It is essentially without concepts and thoughts. It is through successive sensory experiences that the infant succeeds in developing a repertoire

---

[13] Hume is a good example. He believes it is 'evident' that the mind associates ideas on the basis of resemblance, contiguity and cause and effect (1978, Book I, Section IV). It is 'not necessary to prove' this. How 'association' actually works is also a topic upon which Hume does not believe he must spend much time. He writes: "Here is a kind of ATTRACTION, which in the mental world will be found to have as extraordinary effects as in the natural, and to shew itself in as many and as various forms. Its effects are every where conspicuous; but as to its causes, they are mostly unknown, and must be revolv'd into *original* qualities of human nature, which I pretend not to explain. Nothing is more requisite of a true philosopher, than to restrain the intemperate desire of searching into causes, and having establish'd any doctrine upon a sufficient number of experiments, rest contented with that, when he sees a farther examination would lead him into obscure and uncertain speculations".

[14] "The dominion of man, in this little world of his own understanding being much what the same as it is in the great world of visible things; wherein his power, however managed by art and skill, reaches no farther than to compound and divide the materials that are made to his hand; but can do nothing towards the making the least particle of new matter, or destroying one atom of what is already in being. The same inability will every one find in himself, who shall go about to fashion in his understanding one simple idea, not received in by his senses from external objects, or by reflection from the operations of his own mind about them. I would have any one try to fancy any taste which had never affected his palate; or frame the idea of a scent he had never smelt: and when he can do this, I will also conclude that a blind man hath ideas of colours, and a deaf man true distinct notions of sounds". Locke, 1975, Book II, Section II.

of concepts and becomes able to instantiate certain thoughts.[15] Since the sensory experiences someone has are also determined her environment, her mental life is a function of her perceptual environment. In other words, our mental life is always a mirror of our environment according to classical empiricists.

A corollary of the empiricist claim that sensory impressions are the building blocks of mental states is skepticism towards the idea of conceptual nativism. According to concept nativism, a concept is not learned and its properties are not determined by properties ‘outside the head’. Clearly, there is a tension between conceptual nativism and the central tenets of the empiricism. Classical empiricists are aware however that they cannot do entirely without some innate cognitive components. They acknowledge the existence of at least two kinds of innate components. First, mental capacities allowing for association or similarity detection must be innate. The mind cannot acquire them from the environment since they are the very condition for accessing the environment in the first place. Second, many classical empiricists accept that basic sensory concepts (e.g., color concepts like [red], [blue]; qualitative concepts like [pain]) are primitive and must be therefore innate. So, while they are all committed to some form of innate structures, classical empiricists keep their number down. In all cases, they reject the possibility of innate concepts that are non-sensory.

[15]“*The soul begins to have ideas when it begins to perceive.* To ask, at what time a man has first any ideas, is to ask, when he begins to perceive;- having ideas, and perception, being the same thing. I know it is an opinion, that the soul always thinks, and that it has the actual perception of ideas in itself constantly, as long as it exists; and that actual thinking is as inseparable from the soul as actual extension is from the body; which if true, to inquire after the beginning of a man's ideas is the same as to inquire after the beginning of his soul. For, by this account, soul and its ideas, as body and its extension, will begin to exist both at the same time”. Locke, 1975, Book II, Section IX.

Concept acquisition, according to classical empiricists, involves processing the disparate and disorganized sensory experiences generated by the environment in order to discover relevant structures and patterns, which will then make up our concepts. This acquisition theory is supposed to explain how we acquire all types of concepts, from commonsense concepts to the most abstract ones.

The theory of concept put forward by classical empiricists provides the basis for their account of linguistic meaning. Linguistic expressions have meanings because they 'stand for' or 'refer' to concepts. In his discussion of meaning (1975, Book III), Locke defines words as "the signs of their ideas" and "in their primary or immediate signification stand for nothing but the ideas in the mind of him that uses them". In more contemporary terminology, the meaning of a linguistic expression is the concept associated to it, a concept which is built out of sensory impressions that have been processed by operations such as association and similarity detection.[16]

3.2 Contemporary empiricism

The empiricism that has become the received view among contemporary philosophers differs from the classical version in some significant ways. For one,

[16] As described, the classical empiricist theory of meaning is a form of semantic internalism; the meaning of a linguistic expression is a state 'inside the head'. Such a characterization, at least in the case of Locke, is not entirely accurate. Indeed, Locke believes that meaning is also individuated by properties 'outside the head'. Prinz (2002 and 2000), for example, argues that Locke defends a two-tiered theory of meaning. The meaning of a linguistic expression is a function of two kinds of content: 'real content' and 'nominal content'. The 'nomical content' is the semantic counterpart of Lockean 'nominal essence', while 'real content' is the counterpart of Lockean 'real essence'. According to Prinz's analysis, Locke holds that a natural kind term like "gold" has in fact two referents that constitute its meaning: the properties that make a substance gold (i.e., a specific atomic configuration) and the ideas I associate with to the substance (i.e., features I believe are stereotypical of gold). Under Prinz's description, Locke appears to be defending a theory of meaning that is strikingly similar to Putnam.

contemporary philosophers have been very critical of the idea that meaning is some kind of 'private idea'. Today, most philosophers take publicity to be a non-negotiable feature of meaning (i.e., Fodor, 1998). Most contemporary philosophers have given up also on the idea that all concepts can be reduced to the kind of basic sensory data that Hume and Locke have in mind (Wittgenstein, 2000; Quine, 1961).[17]

One element that has been passed down from classical empiricism to contemporary empiricism with little or no modification is the theory of acquisition.[18] Today's empiricists still believe that acquisition is to be explained in terms of *learning from* evidence found in the environment. Like classical empiricists, contemporary empiricists see learning as the product of domain-general operations. These operations are strikingly similar to those presented by their predecessors. For instance, Quine believes acquisition depends crucially on similarity detection, which is made possible by a 'similarity space'. While classical empiricists were always unclear about the etiology of the primitive cognitive operations they hypothesized, Quine, as a self-declared 'naturalist', believes they are neurologically based and probably evolved.[19] But apart from

[17] But see Prinz (2002) for a contemporary attempt to revive the empiricist hypothesis that all concepts are built out of sensory concepts.

[18] "Acquisition", unless explicitly specified, is theoretically neutral with respect to the rationalism and empiricism debate. Empiricism and rationalism are two different research programs addressing the issue of acquisition. "Learning", however, will be used to refer specifically to the empiricist theory of acquisition.

[19] Exposition of the notion of 'similarity space' can be found in Quine's article 'Natural kinds' in *Ontological relativity and other Essays* (1969, 114-138). Quine (1960, 20; 1969b) recognizes that it is difficult to offer a satisfactory definition of similarity. After assessing various options, he ends up arguing that our similarity standard is innately determined. He suggests that it might depend on a 'neurological mechanism' that is 'undoubtedly fundamental though unknown'. Quine thinks selective advantages explain why we have such a capacity. This pretty much represents Quine's positive view on similarity. To be fair to Quine, he might have believed that it was the task of psychologists to provide us with a more substantial account of similarity. But given his

these precisions, Quine's model of acquisition does not differ markedly from Hume and Locke. The empiricist doctrine of acquisition is also at the heart of the connectionist program. Neural nets are models of the prototypical empiricist learner who can only rely on pattern recognition over evidence in order to 'learn'. The fact that so much effort is invested in the connectionist program proves that many still consider the empiricist doctrine of acquisition to be the 'state of the art'.

Below, I examine how contemporary philosophers explain language acquisition. It will become clear that empiricism is the model they defend.

3.3 Bootstrapping into language: the contemporary empiricist account of language acquisition.

From the empiricist perspective, the first step towards language acquisition is the *association* of a sound (or gesture), which will play the role of linguistic sign, with something from or/and generated environment. Contemporary empiricist philosophers differ in their understanding of terms involved in the process of association. For Quine, the initial association is between a sign and some "exo-receptor excitation pattern" (1960, 31; 1990, 41).[20] Davidson takes the association to be between a sign and things like colors, behaviors, etc. that can cause sensory impressions.[21] While this distinction does have some philosophical import, it can safely be ignored for our purpose. What is true of all empiricists, and that which we will be concerned with, is the general claim that one acquires

---

commitment to behaviorism, one can wonder whether a robust cognitive theory of similarity (i.e., like the one proposed by Fodor (1998) in which he posits the existence of highly specific mechanisms geared towards the acquisition of individual concepts) would be acceptable to Quine.

[20] An 'exo-receptor' is a system by means of which the environment can make an impression on us (i.e., sense organs).

[21] See Quine (1990) for a discussion of Davidson's position and how it differs from Quine's view.

language by first associating a sign with an experience generated by the environment. To understand how the association takes place and how it constitutes the first step towards language acquisition, let's take as a case study the acquisition of the lexical term "green".

At time *t*, the child experiences a particular pattern of exo-receptor excitation, call it SI_G, that includes among other things a particular type of visual sensory impression (i.e., the visual sensory impression of green), while looking at an object, O_G. SI_G and O_G make up the state of affairs ST_G. At the same time *t*, the child also experiences an auditory sensory stimulation, call it ASI_G, that consists in hearing the sound *green*. The simultaneous occurrence of ASI_G and ST_G creates a connection between both elements. From now on, the child will take *green* to be associated in some way with ST_G.

This initial association of a sign with a state of affairs is the child's 'entering wedge' into language (Quine, 1990, 39). But this is still a very precarious and inconclusive beginning. As Wittgenstein (2000, paragraph 26) points out, it is at best a 'preparatory' step towards the acquisition of a concept. Indeed, the child's achievement amounts to the association of a sound with a complex state of affairs, viz. the sound *green* with SI_G and O_G. But this is not equivalent to the association of the sound *green* *qua* linguistic sign with the concept [green]. One should not confuse, as Frege (1994) and Wittgenstein (2000) made clear, the concept [green] with the green object or the private sensory impression of green.

Classical empiricists sometimes ignore this fundamental distinction. They can afford to because they assume that a sensory impression can be a concept.

They think that the child stores in her memory a representation of the initial sensory stimulation (i.e., a mental image of green), and compares new sensory stimulations to this 'image' to determine whether they fall under it (Hume, 1978, Book I, Section VII). Many philosophers, especially those working in the tradition of the later Wittgenstein (2000), reject this naïve form of empiricism.[22] For one, this account begs the question under consideration. It is not sufficient to say that the child takes the initial sensory experience as being a sample by which she judges other sensory experiences. We must explain how she learns (1) what is the function of a sample and (2) that a given sensory experience should be used as a sample.[23] Classical empiricists are mute on these two questions. As a result, the notion of sample is just as under-defined as that of concept, and cannot be used to shed some light on the latter.

A further difficulty stems from the fact that sensory impressions are private mental states.[24] Wittgenstein (2000, paragraph 56) shows that it is hard to

[22] Philosophers are not alone to reject this view. Behaviorist psychologists are equally dismissive of the naïve empiricist position and its reliance on private mental entities. Some non-behaviorist psychologists also attack the idea that concept acquisition amounts to simple association of sound and sensory impression. Vygotsky (1962, 6) writes in his *Thought and Language*: "In accordance with the dominant trend, psychology has until recently depicted the matter in an oversimplified way. It was assumed that the means of communication was the sign (the word or sound); that through simultaneous occurrence a sound could become associated with the content of any experience and then serve to convey the same content to other human beings".

[23] For Wittgenstein's formulation of the problem, see *Philosophical Investigations*, paragraphs 75 and 76. The following quote is representative of Wittgenstein's objection to the naïve empiricist story: "But for such a schema to be understood as a *schema*, and not as the shape of a particular leaf, and for a slip of pure green to be understood as a sample of all that is greenish and not as a sample of pure green—this in turn resides in the way the samples are used". For a fictional but nonetheless enlightening example of the non-obvious character of the operation of inferring concepts from individual sensory experiences, see Borges' short-story *Funes the Memorious* (example from Pinker, 2000, 281)

[24] It is an exegetical question whether all classical empiricists considered sense impressions to be 'private', at least in the sense that this notion is used today.

make sense of the process of *privately* comparing sensory impressions.[25] How can we make sure that we remember the sample correctly and that we are reliably comparing new sensory impressions with it? Others (e.g., Dummett, 1996; Fodor, 1998) think the naïve empiricist account is incompatible with the possibility of communication. If concepts are private samples based on past sensory experiences, how can we have genuine communication (i.e., exchange of identical or at least highly similar concepts) between speakers whose concepts differ because they are constituted by their idiosyncratic sensory impressions? And even if they did share identical or sufficiently similar concepts, they could never know because their concepts *cum* samples are private and cannot be compared. In the end, the samples become irrelevant in explaining the process and the success of communication.[26] These and other problems plaguing imagism and mentalism have led many philosophers to follow Quine (1970) in his conclusion that private concepts "are pointless and pernicious in language theory".[27]

Lastly, according to contemporary critics, classical empiricism offers no mechanism to ensure that the child assigns the right sensory impression *cum* concept to the right linguistic sign. Consider the case of a child who is staring at a green wall while simultaneously hearing *wall*. It is possible that the child associates the sign *wall* with the visual sensory impression of green she is experiencing at this moment. This is problematic if the goal is the acquisition of the meaning of the English noun "wall". Wittgenstein and Quine examine this

[25] Wittgenstein's *Notes for Lectures on 'Private Experience' and 'Sense Data'* (1989) also offers illuminating discussion of these issues.
[26] See Wittgenstein's beautiful metaphor of the 'beetle in the box' in *Philosophical Investigation*, paragraph 293.
[27] This being said, not all contemporary empiricists reject the idea that concepts are best defined as samples elaborated from sensory impressions. See Prinz (2002) for a recent example.

problem in their discussion of ostensive definitions[28]. Pointing and naming, just as the co-occurrence of a sound and a sensory impression, do not offer a foolproof method of concept attainment. At any given moment, a vast array of sensory impressions co-occurs with a given linguistic sign. We cannot expect that it will always be obvious to the child which sensory impression(s) must be associated with which sound. Hence, we cannot expect language acquisition to proceed smoothly and reliably unless there are some mechanisms that guide the child in making the correct sound/sensory impression associations.

From the above, it follows that additional mechanisms are needed in order (1) to ensure that the child comes to see that a linguistic sign stands for a concept and not a particular sensory impression, object or event, and (2) to correct the child when she makes erroneous associations. Contemporary empiricists argue that (1) and (2) can be dealt with by independent but mutually sustaining operations, namely similarity detection, abstraction, generalization and reinforcement.[29] Take the case of a child who heard *green* uttered once. When the child hears the same sound uttered again in a new situation, contemporary empiricists claim that she does not simply discard the first association she made with the initial sensory impression and generate a new association on what she just experienced. Instead, the child tries to determine, by means of a similarity

[28] The gist of Wittgenstein's position on ostensive definitions can be found in 2000, paragraph 28. Quine addresses the topic of ostensive definitions in (1960).

[29] The names given to these mechanisms, either individually or as a group, vary greatly in the empiricist literature. 'Reinforcement' is sometimes replaced by 'conditioning' or 'feedback mechanisms'. 'Similarity detection' is referred to as a capacity to detect 'analogies'. Taken together, these mechanisms are often labeled as constituting an 'inductive capacity', 'inferential capacity' or 'general intelligence'. As a result, acquisition of concepts by these means is considered instances of 'acquisition by induction' or 'learning by analogy'. I take it that all these expressions are related to the same fundamental assumptions and are basically equivalent. I will use them interchangeably.

measuring mental operation, what are the common properties of the two experiences that co-occurred with *green*.[30] The visual sensory impression of green, empiricists assume, will be one element that recurs in both contexts. Similarity detection goes hand-in-hand with a process of abstraction. Empiricists claim that the child discards the non-recurring properties of the experiences associated with the two occurrences of *green*. The last step involves generalization: the child generalizes from her past experiences and concludes that *green* does not stand for a particular sensory impression, but for something more general, namely the concept [green]. A concept, according to contemporary empiricists like Wittgenstein, Sellars, Quine *et al.*, consists in an ability. In the case of [green], the ability includes:

- the capacity to discriminate certain sensory impressions, namely sensory impressions of green, from other sensory impressions;
- the capacity to entertain certain thoughts, namely green-thoughts;
- the capacity to use the word “green” to communicate the concept [green] to other members of the speech community.

With each new utterance of *green* that is concomitant with properties that are similar to those that initially generated the concept [green], the strength of the association between the sound and the concept is positively reinforced. New occurrences are supposed to allow the child to ‘work out’ the concept’s intricacies. The greater the sample of situations when the sign is associated with the ‘right’ properties, the greater chance the child has of successfully abstracting the concept. Conceptual competence is a constant work in progress that is driven

[30] See for example Quine (1969, 117).

by 'trial and error'. When there is no repeated co-occurrence of a sign with sufficiently similar experiences, no stable association is generated and concept acquisition is jeopardized.

Contemporary empiricists argue that inductive learning has one powerful property that makes it especially well suited for concept acquisition: it is an inherently self-correcting procedure. Imagine the case of a child who associates the sound *wall* with the concept [green]. According to empiricists, she is bound to encounter many instances where *wall* is not concomitant with, for instance, the visual sensory impression caused by green objects. This is supposed to lead the child to reassess the initial association and discard it because of insufficient positive reinforcement. Not unlike a scientist who revises her hypothesis after coming across conflicting data, the child also adjusts her conceptual hypothesis, empiricists contend. Using her similarity detecting capacity, she processes sensory evidence in an attempt to determine what should be associated to *wall*. While there is no stable correlation between *wall* and the visual sensory impression of green, sensory impressions caused by vertical, continuous and flat surfaces reliably co-occur with this sound. A new association *cum* hypothesis is generated and can be put to the test.

During the early stages of language acquisition, the child is best described as a serendipitous learner. She depends on the correlations she is lucky enough to encounter to form and assess her sign/concept pairs. She has yet to test actively her newly acquired linguistic knowledge by using it. This happens as soon as she starts talking, according to contemporary empiricists. As an illustration, take the case of a child who made the association between *dog* and [dog] *qua* [four-legged, fury, moving and non-talking entity] based on her past experiences. Imagine that one day she is taken to the zoo and sees the bears exhibit. Furthermore, imagine that she points to a bear and says "Dog!" Empiricists think it is likely that her parents will correct her by saying "No! This is not a dog. This is a bear". This single experience is believed to offer two important clues to the child. On the basis of this information the child is expected to refine the concept associated with *dog* by contrasting sensory impressions caused by dogs and bears, the difference in the context of use of *dog* and *bear*, etc. Second, empiricists make the claim that she has now acquired a new sound/concept (or proto-concept at this stage) pairing: *bear* + sensory impressions caused by a bear. When the child becomes capable of using linguistic expressions to express herself, the acquisition process is said to be turbocharged, leading to an almost exponential growth of the primitive lexicon (e.g., Quine, 1960). The child no longer has to wait passively for others to use a lexical item to check whether her comprehension is correct. Instead, she actively tests and refines her associations by using the expressions in different contexts, and evaluating the positive or negative responses offered by the speakers around her.[31] Contemporary empiricists argue that she is able to do this because of her 'generalization capacity' by means of which she can identify a linguistic expression's context of appropriate use. The active participation of the community in the acquisition

[31] There is a wide range of behaviors that can play the role of reinforcement according to empiricists. In addition to rewards (e.g., food, money, privileges, etc.) and punishments (e.g., physical punishments, restrictions, etc.), the child is also capable of perceiving subtler cues that indicate approbation or disapprobation. Facial configurations (e.g., smile, smirk, etc.), bodily movements (e.g., nodding, turning away, etc.) utterances (e.g., "good", "yes", "hum…", etc) and many other types of human conducts are said to be used by the child to determine whether her utterances are adequate or not.

process is thought to provide the child with the necessary guidance to achieve full linguistic competence. In fact, the community is best described, form the empiricist perspective, as training the child in the proper use of linguistic expressions. Acquiring a word is essentially, as Wittgenstein and others contend, becoming familiar with the usage of the word in a community. The child's goal is to discover this usage, and she does so by testing hypotheses as to what the correct usage might be. Acquisition of a whole language is, to paraphrase Quine, coming to share a particular 'worldview' and the intricate 'web of beliefs' accepted by a community.

In a child's early years, empiricists believe that her environment provides her with multiple occasions to discover new sign/concept pairs and to test them. They point out that children are usually raised in contexts where they hear people talk about a variety of topics in diverse situations. Furthermore, when speakers interact with a child, it is assumed that they tend to use syntactically simpler and semantically explicit expressions. They are supposed to repeat abundantly and use all sorts of behavioral cues to facilitate the acquisition of sign/concept pairs by the child. This special idiom is usually referred to as *motherese*.[32] The child is also encouraged, it is claimed, to test her linguistic skills giving parents ample opportunities to correct them. Mostly through games that elicit verbal responses from the child (e.g., "What is this?", "Where is the X?"), the parents can assess her conceptual proficiency. Because the child spends her first years in what empiricists see as an information rich environment, she can quickly acquire new

[32] Quine (1960) and Putnam (1979b, 114) highlight the importance of motherese for the empiricist account of language acquisition.

linguistic expressions. Usually, the first expressions acquired are those pertaining to perceptually salient or subjectively important features of the environment.[33] These denote objects (e.g., "dog", "milk", "shirt"), properties (e.g., "red", "green", "big", "quick"), and actions (e.g., "stop", "sit", "come", "give"). Empiricists highlight the fact that the child naturally acquires linguistic expressions that fall under the categories of *noun*, *adjective*, *adverb* and *verb*. These syntactic categories are learned without effort and essentially for 'free' when the child acquires her first words, according to empiricists. This should not surprise us, they believe. As Putnam points out (1979b, 111), the syntactic taxonomy of natural language and the ontology it embodies prove especially well suited to human needs. Purely pragmatic reasons explain why we have adopted this way of organizing language.

At this stage, the child's linguistic competence has progressed substantially, but it is far from fully realized yet. She associates certain signs with concepts and is able to use them in conformity with the usage of her community. Yet, adult linguistic competence involves more. At this point, the expressive range of the child's language is still limited to concepts that are intimately tied to directly observable properties. It still remains to be explained how she can acquire complex and abstract concepts that are not related to perceptually salient properties. Such complex and abstract concepts are part and parcel of language and give its expressive breadth to human language. Moreover, empiricists have

[33] Quine writes about this: "Linguistically, and hence conceptually, the things in sharpest focus are the things that are public enough to be talked of publicly, common and conspicuous enough to be talked of often, and near enough the sense to be quickly identified and learned by name; it is to these that words apply first and foremost". (1960, 1) Compare Quine's statement with Locke's discussion of language acquisition in (1975, Book III).

yet to explain how the child acquires the syntactic rules governing language. The focus so far as been semantics, but this is only a component of linguistic competence. A fluent speaker not only acquires the correct sign/concept pairs of her target language, but the rules allowing for the concatenation of lexical items into grammatical sentences.

For contemporary empiricists, the acquisition of abstract concepts and of syntax is made possible when the child becomes aware of a specific feature of natural language: compositionality. Compositionality is a property of human language that allows the compounding of lexical items into complex linguistic expressions whose meaning is a function of the meaning of the component lexical items. The child discovers and masters compositionality by a process that relies on the same simple mental operations discussed earlier: similarity detection, abstraction, generalization and reinforcement. According to empiricists, the child begins by noticing that longer utterances have similar sound clusters. Consider the following case: the child hears *red brick*, *red ball*, and *red shirt* in conjunction with the relevant sensory impressions. What these three different utterances share is the same initial sound cluster *red*. Because of her capacity to recognize similarity, empiricists contend that the child detects this common feature. Moreover, they argue that she also notices that all three cases the sound cluster is heard while she was experiencing a particular sensory impression. Since *red* and the sensory impression red correlate reliably, the child is supposed to construct the hypothesis that the concept associated to *red* is a function of the common features of her experience. In addition, this situation is said to provide the child with sufficient data to make further hypotheses. One of them, empiricists claim, is that the different sound cluster that follow *red* (e.g., *brick*, *ball* and *shirt*) are to be associated with other properties of her experiences (respectively brickness, ballness and shirtness.) Lastly, the child is assumed to hypothesize, using her generalization faculty, that the expression “red” is used to modify expressions that follow it. This last hypothesis is warranted, empiricists affirm, by the fact that the properties experienced by the child were simultaneously of red and brick, red and ball, and red and shirt. Finally, she concludes that by annexing “red” to a given expression, say “X”, the concept elicited is the conjunction of [X] and [red].

Joining all these hypotheses, the child is expected to elaborate a single hypothesis capturing the signification of compound linguistic expressions in which “red” is present:

(27) The conceptual content of an expression of the form “red x” (where x is a variable standing for a linguistic expression) is [red] + [x].

This hypothesis is fundamentally different from the ones considered so far. The main difference is that it provides both semantic and syntactic information. Not only does it specify the conceptual content of the expression (i.e. [red] + [x]), but it determines how the signs are to be combined (i.e. “red” followed by “x”) to yield a well-formed linguistic expression. This is a major change insofar as hypotheses generated by the child until now dealt strictly with the pairing of signs and concepts. Prior to this moment, the child had no grasp of syntax. All her linguistic expressions were one-word sentences (Quine, 1960). But as soon as the child discovers the compositional nature of language, the syntactical rules governing the structural organizations of expressions are parsed and used to acquire the syntax of the target language. The child is said to realize that "shirt red" and "red shirt" do not have the same reinforcement patterns. The community accepts the former but rejects the latter. Furthermore, she is also expected to discover, using the cognitive operations listed above, that not all linguistic components can be appended to "red". If she utters "red walk", she is bound to be corrected. The same is true if she says "red be", "red roughness" and so on. As a result, the child is expected to replace (27) with something like (28):

(28) The conceptual content of the ordered pair "red x" (where "x" is a variable that can be replaced by an expression associated to objects in contrast to actions or properties) is [red] + [x].

(28) does a better job specifying both the semantic and syntactic rules governing expressions of the form "red x". Yet, (28) remains a working hypothesis that the child is bound to modify if she encounters conflicting data. From the empiricist perspective, all the syntactical rules governing language are acquired in a process similar to learning the syntax of "red x". Children pick up syntactical rules extracting recurring structural patterns found in the linguistic expressions they hear.[34]

Understanding of compositionality enables the child, empiricists contend, to bootstrap herself into syntax. It also enables her to acquire concepts by means of explanations. An explanation provides her with conceptual data, which she can use towards acquisition of a concept. The efficiency of this method is obvious: there is a direct transmission of conceptual data from the interlocutor to the child.

[34] See Putnam (1979b, 112) and Quine (1990). Both consider syntactical rules to be mere 'grammatical trends' (Quine, 1990, 41) that the child must discover.

Obviously, for an explanation to play its role it must contain concepts that the child already possesses and she must master the syntactic principles used in the statement. When this is not the case, unknown concepts and syntactic principles found in the explanation must be defined. Ultimately, there will be a point of contact with the child's current linguistic knowledge and the regress will stop. With the progressive development of the child's conceptual lexicon and syntactic competence, explanations can carry more information and become more effective as teaching tools. It is in that sense that Quine talks of 'recursion setting in', with the result that language acquisition becomes gradually easier. Acquisition by means of explanation is especially useful for concepts that do not have obvious perceptual signatures. Think of concepts like [mind], [intention] or [justice].

3.4 The scientific foundation of the empiricist model

Historically, empiricist philosophers have provided little concrete characterization of the cognitive operations involved in learning. Most accounts rely on our intuitive understanding of the operations of similarity detection, abstraction, generalization and reinforcement. This has long been considered a serious weakness of the empiricist account. Recently, some psychologists and cognitive scientists have tried to elaborate a theory that describes these cognitive operations and their contribution to language acquisition. Some contemporary empiricist philosophers have welcomed this outside help and integrated the insights of psychologists and cognitive scientists in their philosophical account (e.g., Churchland, 1995; Prinz, 2002).

In the eyes of many, the most promising model of learning is connectionism. The fundamental insight of connectionism is that cognition is best understood if we think of the mind as a distributed parallel computer or neural network. A neural net is made of a number of interconnected nodes that are hierarchically organized in layers. There are three kinds of nodes that can be found in a neural net: input nodes, output nodes and hidden nodes. Input nodes are the entry points of the input in the system. They receive the input from the 'outside world' and represent it in such a way that the network can process it. Output nodes return the result of the computational work done by the network. Hidden nodes stand between input and output layers. They are called 'hidden' because they have no direct contact with the outside world nor do they generate final output values. They receive their input from other nodes in the network rather than directly from the outside world, and their output is transmitted to other nodes. Very simple neural networks have only input and output layers (i.e., 2 level nets). These networks have limited computational capabilities. In order to handle more complex computational tasks, one needs to add hidden layers between input and output layers. For each node of the network, the incoming signal must reach a minimal strength level if the node is to be activated. This is called the 'activation threshold' of the node. Nodes are linked together by 'weighted connections', which means that connections are not necessarily transparent but can modify the signals that pass through them. A connection can increase the strength of the signal it carries, decrease it or leave it unchanged. The computational capabilities of a neural net are a function of both its architecture (i.e., number of nodes, layers and the topology of the network) and the weight of inter-nodal connections.

Connectionists claim that neural networks can *learn* to carry out complex computational tasks. It is possible to start with a neural net that has arbitrarily set connection weights, and progressively 'train' it until it provides output values that match those generated by a given computational function. There are various methods used to train neural nets. Most frequently mentioned are Hebbian learning and 'backpropagation'[35] (Elman *et al.*, 1996, 57-73). Hebbian learning involves the optimization of the network's connections to reflect recurrent patterns in past input. This learning model is inspired by the phenomenon of neuronal potentiation that results from the repeated stimulation of neurons. Neuronal potentiation is described by Hebb in the following terms:

> When an axon of cell A is near enough to excite a cell B and repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that A's efficiency, as one of the cells firing B, is increased. (Quoted in Elman *et al.*, 1996, 57)

Hebbian learning is the same process but applied to artificial neural nets—the latency of the connection between nodes increases or decreases proportionally with the activity between the nodes. Backpropagation is a slightly more complex learning technique. It uses error information gathered from the analysis of the neural network's output to reconfigure connection weights. In order to use this method, we need a set of values that will be used to train the network. This set contains pairs of values; each pair consists of an input value and the result of the computational function applied to this input value (i.e., target value). The training

[35] For simplicity's sake, I consider 'perceptron convergence procedure' to be a case of backpropagation for two-layer network.

begins by entering the first input value of the training set in the neural net to generate an output value. Then, the output value is compared with the target value associated to the input value. If output value and target value differ, the network is incorrectly configured (i.e., connections weights are not properly set) to realize this specific computational function.[36] To correct the situation, a precise characterization of the neural net's failure is needed to determine how it must be reconfigured. This is achieved by quantifying the difference between the output and target values to get the error value. The goal is now to bring the error value at an acceptable level. This requires the calibration of connection to minimize the error value. The best configuration of connection weights is found by recursively going through all possible connection weight configurations. The configuration yielding the lowest error value is implemented. This procedure is carried out for each pair in the training set. After processing a sufficient number of training values and being recalibrated, the neural net reaches a stage where its output values are very close or even identical to the target values. If the training set was adequately constituted, the neural net should have internalized the computational function for which it was trained, and will provide correct outputs even for input values that were not in the training set. If this is the case, the network is described as having 'learned' this computational function.

Hebbian learning and backpropagation are two methods with particular advantages and disadvantages. Hebbian learning is simple and robust, but it works only for certain problems. Backpropagation is a much more powerful

[36]Obviously, the architecture of the network must be compatible with the computational function that is to be implemented. There are models of neural nets with adaptive architectures that change to fit the computational function that must be learned.

technique. In fact, using backpropagation it is possible to teach a neural net any computational function that is compatible with its architectural features (Elman *et al*., 1996, 65). The only limiting factor is the quality of the training set. In order for the training to be successful, the training set must be sufficiently representative of the output values generated by the computational function.

From this quick look at neural nets, one can easily understand why empiricist philosophers are excited by connectionism. First, it offers them a computational model for a domain general learning mechanism that is highly dependent on the environment. Starting from a randomly defined structural organization, neural nets are gradually shaped by the pressures of the environment (i.e., the training set) until they reach an optimal network topology for the job they are assigned (i.e., a specific computational function). As we saw above, empiricists are trying to elaborate a philosophical account of learning that proceeds along these lines. There is a second feature of neural nets that make them very attractive for empiricists. Neural nets are said to closely resemble the brain's neurophysiological organization. The brain is a vast network of neurons whose functions can be assimilated to those of nodes in a neural net. Exoreceptor neurons with terminations in sense organs play the role of input nodes. Neurons with terminations in various performance systems (e.g., motor systems, etc.) are the output nodes. Between these two types of neurons, we find a massive number of neurons that are described as the functional equivalent of hidden nodes. Just like a node, a neuron has an activation threshold and its connections to other neurons are weighted. Neuronal activation threshold and connection weight are adjustable and have been shown to change in reaction to internal and external stimuli. In sum, connectionists and empiricists see the neural net and the brain as structural analogues. The main difference between the two is the physical substrate involved; a neural net is silicon-based piece of hardware driven by some software while a brain is carbon-based piece of wetware. By providing a well-defined computational model that is thought to be a biological analogue of the brain, connectionism fills some of the gaps found in the contemporary empiricist doctrine. Indeed, contemporary empiricists have little to say about the actual computational and biological implementation of their learning model. Connectionism might change all this, allowing for a 'naturalized' empiricist theory.

But in order for connectionism to play the role empiricists expect it to play, it is must be shown that a neural net can acquire concepts and complex cognitive competences like language. On the basis of the description offered above, it is not clear that neural nets can accomplish this task. In the last twenty years, connectionists have put a tremendous amount of effort towards showing that neural nets can in fact acquire all sorts of concepts and competence. From emotion recognition to the differentiation of lexical categories, connectionists have built neural nets that are said to accomplish these tasks. These models are often used to support the claim that 'cerebral neural nets' could drive human learning. In all cases, the models proposed are essentially the same; this is to be expected since neural nets are domain general learning mechanisms. For our purpose, I will focus on models for concept and language acquisition.

Acquisition of concepts and language starts at the level of sensory organs. Sensory organs play the role of input nodes for the brain *cum* neural network.

They contain a number of exoreceptors, each configured to detect particular properties of the environment. For instance, the retina is made up of cells that are specialized in the detection of specific properties of visual scenes.[37] Depending on the properties of the scene, the activation pattern of retinal exoreceptors will vary. For each visual scene, exoreceptors generate an array of excitatory values that constitutes its 'signature'. In other words, the visual scene is *represented* as a vector of exoreceptor stimulation values. It is this representation that will be the input for the brain's computational operations. The exoreceptors and their states determine the input available to the brain. Thus, the number and resolution of exoreceptors delimit the space of possible input values. Borrowing an example used by Churchland (1995), taste is perceived by means of four kinds of exoreceptors that detect respectively sweetness, sourness, saltiness and bitterness. Hence, the domain of all possible tastes available to human beings can be represented as a four-dimensional space where the axes are gradations of sweetness, sourness, saltiness and bitterness tastes. Any taste that can be perceived is represented as a point in that space, point which is defined by an array of four values.[38]

Because sensations can be precisely quantified, connectionists think that they can be compared systematically. If a gustatory sensation G_1 is defined by the

---

[37] Here I follow the usual description of the visual system preferred by empiricists, which is fundamentally externalist. Many have argued (correctly I believe) that our best account of the visual system will be internalist in nature (e.g., McGilvray, 1994; Marr, 1982). According to the internalist description, the retina is an array of rods and cones, each of which fires at rate that is a function of its level of excitation. The firing rate of each cell is determined by its type (e.g., there are different types of cones and rods), the type of excitation it is subjected to, and other variables like habituation and fatigue.

[38] It is possible that the 'taste space' is more complex than Churchland makes it. However, he believes that the general picture, namely that each taste can be captured by a set of *n* exoreceptor excitation values, is correct.

following array of values [2;5;1;10] and a second sensation G_2 by the array [10;1;2;1], the differences between the two can be assessed accurately. Overall, sensation G_2 is sweet while sensation G_1 is predominantly bitter with some accents of sourness. By the same means, it becomes possible, it is thought, to assess the similarity relations. Similar sensations share similar arrays of excitatory values and cluster in the same region of the sensory space delimited by the properties of exoreceptors. This is the first dividend of connectionism for empiricist philosophers: it provides a robust notion of similarity. All empiricists claim that humans have the ability to recognize similarities. Yet, it remained very obscure how this actually worked. Quine talks of a 'similarity space' and an 'internal similarity measure' that enable us to compare sensations and detect significant similarities. Connectionism fleshes out, or so it seems, these Quinean notions. The 'similarity space' is the sensory space defined by the properties of the exoreceptors. The 'similarity measure' is the distance, which can be objectively measured, that separates two sensations in the sensory space. The fundamental fuzziness of the classical notion of similarity is replaced by a function over vectors that can be quantified (Churchland, 1995).

Detection of similarities is the first step towards concept acquisition according to the empiricist story. Primitive concepts are believed to be extracted from stable clusters of sensory stimulations, according to empiricists. The concept [red] captures the child's experience that red things are similar in an important respect, namely their redness. Here again, the connectionist hypothesis offers a model to understand the generation of concepts. Because of our visual system's structure, red things cause visual sensations that cluster in a given section of the color-sensory space. Objects of different colors cause stimulations that occupy other regions of the visual space. Thus, it would appear that the interaction between our sensory organs and the world leads to the emergence of sensory clusters and to the segmentation of the child's sensory space in distinct sections. These clusters map the recurrent properties found in the world. From the connectionist perspective, these clusters are concepts.[39]

Concepts are not represented individually in the brain *cum* neural net, according to the connectionist model. Rather, it is the entire neuronal network topology that represents all the concepts.[40] Repeated sensory stimulation is said to progressively modify the overall structure of the neuronal network by changes in connection weights between neurons. Recurring instances of similar sensory stimulations lead to the optimization of certain neuronal pathways and the 'atrophy' of others. In the behaviorist terminology often favored by empiricists, we could say that certain pathways are 'positively reinforced' while others are 'negatively reinforced'. The end result of this process is that the segmentation of the sensory space ends up being represented at the level of the hidden layers of the brain/synaptic network. Conceptual knowledge amounts to the successful internalization of various ways of dividing the sensory space.

Connectionists believe their model scales very well and can account for the formation of complex concepts. What distinguishes complex concepts from

---

[39] Churchland (1995, 50) writes: "Not to put too fine an edge on it, what the network has developed during training is a family of rudimentary concepts, concepts that get variously activated by sensory inputs of the appropriate kind. […] The suggestion we are exploring is that the appearance of concepts in living cognitive creatures consists in the same sort of learned partitioning of neuronal activation spaces".

[40] Connectionism is compatible with some forms of modularity. Thus, it is possible that the brain is constituted of independent neural networks. If we assume that this is the case, then concepts are not represented individually but by a whole module.

simple ones like [red] is that the former cannot be reduced to regions of the similarity space associated to specific sensory organs. Instead, complex concepts map clusters, patterns and abstract relations that emerge when processing a much wider array of sensory input, coming from many or all sensory organs, for more than only basic similarity relations. In most cases, acquisition of complex concepts depends on the detection of subtle statistical periodicity and/or abstract structural organization in the input, both of which can be detected only after significant exposure to relevant sensory stimulations and also active training. This sophisticated kind of processing is not needed for the formation of [red]. As we saw, the brain *cum* neural network is believed to home in almost automatically on the concept by simply trying to optimize its neural circuitry for the type of input data it receives. In other words, connectionists would argue that [red] is most likely acquired by a method of Hebbian learning, which is essentially a passive form of training. Complex concepts typically require more than Hebbian learning because their conceptual contents are more intricate. The challenge for the brain *cum* neural network is to sift through the wealth of input data and identify the *relevant* patterns and abstract relations that play the role of conceptual contents. This is far from a trivial task to the extent that the input data support many patterns and abstract relations that are of no interest. So, there must be a mechanism that will allow the brain *cum* neural network to reject irrelevant patterns and relations, and concentrate on those that are important. Empiricists have traditionally argued that it is the positive or negative feedback that the child gets when acquiring complex concepts that enables her to progressively internalize concepts. Connectionists also believe that a kind of reinforcement is crucial in order for the brain *cum* neuronal network to succeed in learning complex concepts. It is for this reason that they see backpropagation as the learning model for complex concept acquisition. Backpropagation involves the dynamic reconfiguration of the neural net on the basis of the correctness of its output. In the case of model neural nets examined by connectionists in their labs, the standard used to determine a network's computational proficiency and what kind of fine-tuning it requires is provided by the training set, which contains examples of input values associated with correct output values. For the child trying to acquire complex concepts, it is the set of positive and negative reinforcement events that plays the role of training set and contributes to configuring the child's brain *cum* neural network. In sum, backpropagation can be described as the transposition of the behaviorist reinforcement model at the explanatory level of the brain described as neural network.

Once concept acquisition has been explained, the hardest part of the problem of language acquisition has been solved, according to empiricists and connectionists. What remains to be accounted for is the learning of speech segmentation, concept/sound pairs, rules of morphology, syntactic categories and grammatical rules for sentence formation. Connectionists think these tasks should not pose a real challenge to the brain *cum* neural network. The way they see it, the ability, associations, categories and structural relations that must be acquired are not overly complex. Connectionists seem to share Putnam's view (1979b, 112) that natural languages are rather simple systems from a computational standpoint. Given the massive computing power of the brain *cum* neural network and the abundance of training data available in the environment, language acquisition should be relatively easy for the child. To support their optimism, connectionists also point to their success in teaching model neural nets, which are simpler than the brain by many orders of magnitude, abilities that are characteristic of linguistic competence. There is a vast literature on these 'achievements', and there is no way for me to do justice to it all here. I will limit myself to a quick overview of what are taken to be some of the significant accomplishments in neural network learning in the domain of language.

Over the last decade, three teams of connectionist researchers have built neural nets that are described as having learned with some degree of success to segment linguistic input (i.e., determine word boundaries and utterance boundaries) without having any prior linguistic knowledge.[41] Neural nets achieve this by tracking phonotactic regularities in the input feed. In two cases, the input is transcribed speech directed to infants taken from the CHILDES data. In a series of papers, Elman (1991, Bates and Elman, 2000) discusses how a simple neural network discovers not only grammatical categories but also grammatical relations on the basis of examples alone. Some of the categories the neural net is said to have detected are [noun], [transitive verb] and [intransitive verb]. Similarly, this neural net is said to detect and represent the grammatical structure of complex sentences. Also of interest, the same network is argued to be able to acquire lexical concepts like [animal], [human], and [breakable]. This is often described as a crucial finding to the extent that it supports the story about concept acquisition discussed above. The last neural net model I want to mention is the

[41] See Aslin, Woodward, LaMendola, and Bever (1996); Chirstiansen et al., (1998); Cairns, Shillcock, Chater, and Levy (1994), (1997); Shillcock, Cairns, Chater, and Levy, (2000). See also Batchelder, E.O. (2002) for a review of these papers.

one developed by Rumelhart and McClelland (1987). It is probably the most cited example of linguistic acquisition by a neural net. In their paper 'On Learning the Past Tenses of English Verbs', they present a neural net that is trained to form past tenses of English verbs. Using a training set containing pairs of verbs in present and past tense forms, the neural network is said to have extracted the relevant patterns commanding past tense formation. On the basis of the information it gathered, the network can output the correct past tense form for some verbs that were not in the training set. According to Rumelhart and McClelland, the network has to have 'learned' the algorithm for past tense formation.

The models proposed by Elman, Rumelhart, McClelland and other connectionists provide some concrete evidence to support the connectionist hypothesis. Clearly, there is quite a gap between the performance of competent speakers and that of the neural nets discussed. Furthermore, the fact that a neural net can master what a child learns does not entail that the child's brain functions like a neural net. Different process (e.g., cognitive, developmental and maybe even physical) might well be responsible for the child's acquisition of language. Nonetheless, the fact that neural nets can successfully carry out some cognitive tasks contributes to the plausibility of the connectionist paradigm.

Connectionists like to argue that the brain is a neural network. They claim that there is empirical evidence that corroborates this hypothesis. To conclude this section on connectionism, I want to examine some empirical data that are supposed to confirm the connectionist model.

Empirical evidence offered by connectionists can be divided into two broad categories: neurological and developmental. Neurological data highlight the structural and functional similarities that exist between the brain and a neural net. The structural similarity aspect has already been discussed above and I will not return to it here. Other neurological considerations that are often put forward in support of connectionism are the plasticity of the brain and the distributed nature of the cognitive activity in the brain (Bates and Elman, 2000, 102-109; Elman *et al.* 1996, 2-4; Churchland, 1995, 61). Many studies show that the brain can be quite resilient to damage. When a section of the brain is destroyed or impaired, other sections often reorganize to carry out the cognitive tasks usually filled by the injured area, at least to some extent. Experiments with animals also show that when tissue from one area of the brain (e.g., visual cortex) is implanted in another area (e.g., auditory cortex), the implanted tissue will contribute to the cognitive operations of the implantation site (e.g., auditory tasks) rather than perform the functions for which it was destined at the extraction site (e.g., visual tasks). New techniques of brain imaging that make it possible to see the brain's operations in real time show that neuronal activity tends to be distributed over different cerebral areas when a given task is accomplished. Empiricists contend that plasticity and distributed activity are two features we would expect the brain to exhibit if it worked like a connectionist neural net. Because all nodes and connections are fundamentally identical, neural nets have a high level of plasticity. Distributed processing is another feature that is a consequence of the design of neural nets.

Developmental data concerning children's cognitive evolution are also used to emphasize the similarities between how children and neural nets learn. For example, many studies show that infants and children are very good at spotting patterns and similarities in sensory input.[42] This capacity, many argue, depends on a domain general statistical detection mechanism. These results are compatible with the connectionist hypothesis. After carrying out a series of experiments on the acquisition of novel verbs by young children (under 3 years of age), Tomasello (2000) draws a number of conclusions that can be interpreted as supporting connectionism. For example, he claims that linguistic knowledge is item based –a child's linguistic knowledge is about individual lexical items (e.g., "dog", "table") and sentence structures (e.g., "I want…") and not general/abstract linguistic categories (i.e., nouns, adverbs) or principles (i.e., a sentence must have a subject and a verb)—and what they know depends on what they experienced directly. Tomasello also contends that children are not genuinely creative before 3; they mostly reuse lexical items and syntactic structures they encountered without much innovation. Finally, the development of linguistic competence follows, he argues, a steady progression that seems to track the increase in linguistic data encountered by the child. Such developmental characteristics are similar to what we come across when we analyze the learning of neural nets.

4 Assessment of the empiricist hypothesis

In the previous section, I examined how language acquisition is supposed to proceed according to the empiricist hypothesis. The time has come to assess

[42] For two recent studies see: Kirkham, N. Z., Slemmer, J. A., Johnson & S.P., 2002, and & Saffran, J.R., Aslin, R. N. & Newport, E.L., 1996.

whether the empiricist proposal constitutes a cogent explanation of language acquisition. The picture that will emerge in the below is that it does not.

In order to make my case, I draw from a wide range of disciplines concerned with the study of language like linguistics, developmental psychology and ethnography. Data coming from these different disciplines conflict with the empiricist hypothesis. To the extent that a theory of language acquisition must meet the requirements of a sound naturalistic theory, this proves devastating for empiricists.

4.1 Evidence and language acquisition

Assuming that she has normal perceptual and cognitive capacities, empiricists predict that the linguistic competence a child acquires will reflect the perceptually accessible evidence available in her environment. This hypothesis entails three empirically testable predictions:

> Prediction 1: If the evidence available in the environment is insufficient, we should observe serious setbacks or even the complete failure of the language acquisition process.
>
> Prediction 2: The linguistic competence attained in an environment where linguistic evidence is poor should differ from the linguistic competence attained in an environment containing rich linguistic evidence.
>
> Prediction 3: Children who have access to radically different types of evidence should achieve different linguistic competence.

Empiricists, both past and present, recognize, either implicitly or explicitly, their commitment to these three predictions. In the opening sections of the Book II of the *Treatise*, Locke argues that the stock of concepts one comes to possess depends on the diversity of sensations experienced (1975, Book II, chapter VII). An environment that offers a richer sample of sensory experiences will provide more opportunities to acquire a larger and richer set of concepts. Conversely, being raised in an environment that provides little in terms sensory experiences will result in an impoverished conceptual repertoire. Locke imagines the case of a child raised in an environment where the only colors visible are black and white. He claims that this child cannot acquire concepts like [green] or [scarlet] because she was never exposed to the right kind of sensory stimulations (1975, Book II, chapter VI). Similarly, a child that only has access to fleeting and inchoate sensory experiences, instead of a stream of well-organized and minimally recurring experiences, cannot be expected to acquire concepts effectively (1975, Book II, chapter 22).[43]

Connectionists' neural networks behave according to the predictions listed above (Marcus, 2003). Leaving out the limits imposed by architectural properties, a neural net's performance is determined by the training set used to train it (Fodor and Pylyshyn, 1988; Marcus, 2003 and 1998). In order for the network to achieve a satisfactory performance, the training set must provide enough opportunities to isolate relevant patterns in the data. This requires a sufficiently large and diversified training set. If the training set is too small or skewed, the neural network's output will suffer.

[43] In chapter 22, Locke claims that a child can only come to 'know [the] objects' if they have made 'lasting impressions' on her mind. 'Lasting impressions' arise from recurrent sensory experiences over time. Recurrence breads familiarity, and familiarity allows the child to distinguish the properties of objects, and to differentiate them from those she already knows well. Aristotle makes the same point in the *Posterior Analytics* (II, 19.99 and onward).

If we can show that the predictions listed above do not obtain when we examine language acquisition by children, then we have good reasons to think that the empiricist model is wrong.

4.1.1 Poverty of evidence

Most empiricists simply assume that the evidence found in the child's environment is sufficient for the acquisition of language via induction. Very few take the time to rigorously examine what evidence language learners *actually* have access to. At best, those who consider the question do so superficially and inaccurately. This approach is obviously inadequate. If one hopes to offer a scientific theory of language acquisition, it is necessary to approach the question of evidence in a systematic fashion. When we do, we discover that the evidence required for the success of the empiricist hypothesis is not found in the child's environment. Instead, we realize that children acquire language despite being raised in environments where the linguistic evidence is impoverished. This falsifies prediction 1. Also, we observe that quantitative and qualitative variations (except in extreme cases) in the evidence base have little impact on the final linguistic competence acquired; this goes against predictions 2 and 3.

With respect to the empiricist model, the evidence for language acquisition is *sufficient* (in contrast to *impoverished*) if and only if it meets the following requirements:[44]

1- **Comprehensiveness**: For each aspect of phonological, syntactic, morphological and semantic competence acquired, the child must have

[44] I devised this list of requirements. I believe it fairly describes the minimal requirements that the evidence set must meet in order for language acquisition to be possible using the inductive mechanisms described by empiricists.

been exposed to relevant positive evidence that allows for its acquisition by means of induction.

2- **Correctness**: The child must have access to evidence that is predominantly correct; that is, it must be accurate with respect to the target language the child is expected to acquire.

3- **Unambiguous**: The positive evidence should not allow for diverging and equally consistent interpretations.

4- **Availability of negative evidence**: To the extent that the positive evidence available is not entirely unambiguous, negative evidence is required to help the child reject supported but nonetheless incorrect linguistic hypotheses.

We must also keep in mind the two requirements mentioned in the discussion of the desideratum 3 (see Part 1, section 2).

5- **Accessibility**: Because of the properties of her sensory and cognitive capacities, the child can only assimilate certain kinds of evidence found in her environment. A theory of language acquisition can only rely on evidence that the child *can* assimilate. Accessibility is defined relatively to the child's *actual* capacities.

6- **Universality**: Evidence that is not accessible to all children who succeed in learning language cannot be a necessary for language acquisition.

Below I argue is that the evidence available to children is neither comprehensive nor unambiguous. Furthermore, negative evidence is virtually nonexistent, and errors are sufficiently prevalent to jeopardize successful inductive learning.

Comprehensiveness

I will begin by assessing the comprehensiveness of phonological, syntactic and morphological evidence. The comprehensiveness of semantic evidence will be addressed last because it raises specific problems.

Empiricists argue that a child relies on two kinds of positive evidence to acquire phonology, syntax and morphology. These are (1) examples of use and (2) direct teaching via explanations and drilling. A child can acquire a given linguistic principle only if she encounters enough sentences that exemplify it or by being actively trained. The latter option can be quickly dismissed. Indeed, there is little evidence that adults actively teach phonology, syntax and morphology. Adults do not sit down with children to explain them that "-s" of "cars" is realized as *z* while the "-s" of "lollipops" is realized as *s*, that one must affix "-ed" to a regular verb's stem in order to get its past tense form, or that sentences are structured entities. One reason why adults do not is that most have no conscious knowledge of these linguistic principles. They follow them automatically, but are incapable of describing or explaining them when asked. But even if adults were able to verbalize these complex principles, it would be to no use. We cannot expect the average child to understand such complex and theory-laden principles at such an early stage in her cognitive and linguistic development. It worth keeping in mind that adults succeed in achieving a *conscious* understanding of the principles underlying natural language only once they have mastered their native language, and gone through substantial scientific training. These are two things that children learning their first language lack.

Children are not *taught* phonology, syntax and morphology. The child must rely on examples of use –what is called 'positive evidence'—as her main source of data. Empiricists claim that by using her inductive capacity (i.e., abstraction and generalization), she analyzes the utterances she encounters to discover regularities and subsequently infers the principles governing language.

From the start, this hypothesis encounters a serious obstacle. All natural languages allow for the production of infinitely many well-formed sentences. Obviously, the child only has access to a finite cross-section of the infinite set of sentences that can be generated by the target language. For an empiricist learner, this is not ideal. The odds of discovering the governing principles of language via induction would be greatly improved if she could analyze the set of all well-formed sentences. Anything short of the complete set of sentences increases the risk of failure.

This is a serious difficulty but not one that is fatal, empiricists argue. The data set might not be exhaustive, but this does not entail that it is not comprehensive, at least in the way required for successful language acquisition via induction. It is possible for a finite sample of sentences to be sufficiently *representative* of a language's linguistic principles to make it possible for an empiricist learner to infer them reliably. In the same way that we can infer that the function y=x+2 generated the set {0,2,4,6,8,10}, empiricists hold that the child infers the grammar of a language from a finite sample of the grammar's output. In both cases, they argue, the very same inductive mechanism is at work. Obviously, principles of phonology, syntax and morphology are much more complex than a simple mathematical function like y=x+2, and the task of discovering them is significantly harder. The difficulty is offset by two factors, empiricists contend. On the one hand, the evidence set from which the child must infer the linguistic principles is quite extensive; it is the set of all the utterances she has access to during her language learning years.[45] On the other, the child is believed to invest a significant amount of time and cognitive energy in language acquisition, which increases the odds of success of the operation.

Empirical data do not support the empiricist explanation. By examining the primary linguistic evidence (henceforth, PLE) available to children, linguists, developmental psychologists, and ethnographers have found that it does not provide a comprehensive cross-section of the phonological, morphological and syntactical features of language. The child acquiring language must work with positive evidence that is incomplete and skewed, making successful acquisition of language by induction impossible. Examples from phonology, syntax, and morphology will prove this.

Phonology[46]

Work in generative phonology (Chomsky and Halle, 1968; Kenstowicz, 1994) has established that it is not the phonetic representation of the word (i.e., the sound *red* for the word "red") that is stored in the lexicon but an abstract representation built out of a finite set of phonological features. These phonological features map possible states of the vocal apparatus. A phonological representation is an array of phonological features that provides the necessary

[45] Empiricists cannot mean that the child has access to all the utterances she heard for the purpose of language acquisition. Human memory has a limited capacity that makes storing all the linguistic data a child comes across impossible. Instead, the claim is that evidence contributes incrementally to language acquisition without being stored. Just as a neural net can acquire a function based on a set of data without having to store them, the child learns language, empiricists argue, from the positive evidence but without storing it.

[46] In the phonology section, I modify the typographical convention: backslashes (i.e., /*/) identify phonetic representations while brackets (i.e., [*]) identify phonological representations (not concept!).

instructions to the vocal apparatus for the production of a linguistic sound. For example, the sound /a/ is equated with the following matrix of features:

- /a/ = [-nasal]
  [+continuant]
  [+consonantal]
  [+low]

The phonological representation of the word "ride" is a four-column matrix, one for each phoneme constitutive of the word (Fromkin (ed.), 2000):

- ride =

[-syllabic]	[+syllabic]	[+syllabic]	[-syllabic]
[+sonorant]	[+sonorant]	[+sonorant]	[-sonorant]
[+consonantal]	[-consonantal]	[-consonantal]	[+consonantal]
[-lateral]	[-front]	[+front]	[-continuant]
[-nasal]	[+low]	[+high]	[-nasal]
[+voice]	[+voice]	[+voice]	[+voice]
/r/	/a/	/ɪ/	/d/

The relationship between the phonological representation and the phonetic representation is a complex one. Depending on the phonological and/or phonetic landscape in which a word is embedded, the phonological representation will have different phonetic realizations. In other words, the relationship between phonological and phonetic representations is one-to-many; a single phonological representation can generate a multitude of phonetic representations.[47]

The process that transforms the phonological representation into a phonetic representation is a rule-governed derivation from the first type of representation to the other. The derivation acts on the phonological representation

---

[47] There are obvious advantages with this implementation. Instead of storing all possible phonetic representations of a word, only the basic phonological representation and the derivation rules need to be memorized, which minimizes the use of memory.

and transforms it by adding or deleting features, which produces a new representation. Without going into all the details, research shows that there are many derivation rules. Some are language invariant while others are language specific. Some rules are triggered by phonological properties, others by phonetic properties. The fact that some rules are sensitive only to phonological features provides strong evidence for the psychological reality of the underlying phonological representation even if only the phonetic representation is actually 'heard'. The application of rules is not free but follows a strict sequential order.

A couple of case studies can be used to illustrate the types of relationship that exist between phonological representation and phonetic representation. The first is Mohanan's study of the Singapore English dialect (Mohanan, 1992 in Kenstowicz, 1994); it highlights the differences between phonological representations and phonetic representations. In this dialect, words like "lift", "ask" and "list" are pronounced /lɪf/, /ɑːs/, and /lɪs/. Focusing on "list", one could assume, on the basis of the phonetic representation, that [t] is absent from the phonological representation of the word. Yet, this is incorrect. While /t/ is not pronounced (i.e., not part of the phonetic representation), there are good reasons to believe that it is present at the phonological level. For example, while speakers of this dialect say /lɪs/, /t/ is pronounced for the word "listing". This indicates that [t] is present in the underlying phonological representation of "list" but deleted in the process of derivation that generates the phonetic representation. Another observation supports the hypothesis that the phonological representation of "list" includes [t]: the plural of "list" is not *liss-es* but *list-s* (i.e.,/lɪs/). This is not the result that we would expect if the underlying phonological representation of "list" were [lɪs]. In most English dialects, when the stem ends in a sibilant (e.g., "hiss") the plural takes a reduced schwa-like vowel (e.g., hiss-[ə]s).

The second case is an example of the specific ordering of rules in the derivation of the phonetic representation from the phonological representation. Two rules are involved in this example: [aɪ] Raising and Flapping. The first states that "[aɪ] is realized as /ʌɪ/ when it precedes a voiceless consonant" (Fromkin (ed.), 2000, 566). The second rule states that "any alveolar stop is realized as /ɾ/ when it is preceded by a vowel or syllabic consonant, and followed by a stressless vowel" (Fromkin (ed.), 2000, 567). Hypotheses about the ordering of these two rules allow us to explain diverging intuitions that speakers of different English dialects have concerning the phonetic representations of words like "writing" and "riding". In certain dialects (call them Type I dialects), "writing" and "riding" have different phonetic realizations, while in others (call them Type II dialects) both words have the same phonetic realization. When "writing" and "riding" differ phonetically, the source of the difference is not, as might be expected, the presence of [t] in the phonological representation of "writing" and [d] in the phonological representation of "riding". Speakers of Type I dialects pronounce both [t] and [d] as /ɾ/ and this can be explained by the Flapping rule. The difference between both words lies instead in the fact that "writing" is realized as /rʌɪɾɪŋ/ and "riding" as /raɪɾɪŋ/. The [aɪ] Raising rule is responsible for the difference (i.e., [ʌɪ] versus [aɪ]) because it applies only to "writing" since [t] but not [d] meets the rule requirements. However, in the dialect where both words share the same phonetic representation (namely, /raɪɾɪŋ/), it seems that the Flapping rule but not [aɪ] Raising rule operates; there is no transformation of the [aɪ] into [ʌɪ] in the passage from the phonological to the phonetic representation. The most convincing explanation for the difference between the dialects is in terms of a different ordering in the application of the Flapping and [aɪ] Raising rules. In Type I dialects, [aɪ] Raising operates before Flapping with the consequence that [t] is visible to the [aɪ] Raising rule, and triggers the change from [aɪ] to [ʌɪ]. This does not happen for "riding" because [d] does not have the properties to trigger [aɪ] Raising. In Type II dialects the order is reversed; Flapping is applied before [aɪ] Raising. This has the consequence that the [t] of "writing" is transformed in [ɾ] before [aɪ] Raising is activated. Unlike [t], [ɾ], just like the [d] of "riding", does not fulfill the requirement for [aɪ] Raising, which means that [aɪ] is not changed in [ʌɪ]. Hence, both "writing" and "riding" have the same phonetic realization in Type II dialects. The table below summarizes the previous explanation (adapted from Fromkin (ed.), 2000, pp. 569-570):

/AI/ Raising precedes Flapping

Step	Writing	Riding	Explanation
1	raɪtɪŋ	raɪdɪŋ	Phonological representation
2	rʌɪtɪŋ	N/A	/AI/ Raising
3	rʌɪɾɪŋ	raɪɾɪŋ	Flapping
4	rʌɪɾɪŋ	raɪɾɪŋ	Resulting phonetic forms

Flapping precedes /AI/ Raising

Step	Writing	Riding	Explanation
1	raɪtɪŋ	raɪdɪŋ	Phonological representation
2	raɪɾɪŋ	raɪɾɪŋ	Flapping
3	N/A	N/A	/AI/ Raising
4	raɪɾɪŋ	raɪɾɪŋ	Resulting phonetic forms

From this short excursus in phonology, we see that the phonological competence the average speaker possesses is both abstract and complex. According to empiricists, the child acquires phonological competence without any prior phonological knowledge and acquires phonology strictly by induction over the PLE. Notice that if this were true, the PLE would be nothing more than a series of clusters of phonetic features. But these provide no information about some crucial aspects of phonological competence. For example, they offer no indication that words are represented as arrays of phonological features, and are mute as to what these phonological features are (e.g., [±nasal], etc.) There is no way to know from the phonetic features that there are two levels of representation (phonological and phonetic) involved in the production of linguistic sounds, and that these representations can be significantly different from each other. Neither do clusters of phonetic features show on their sleeves that they are the product of a strictly ordered rule-based derivation process on abstract representations. Hence, acquisition of phonology takes place in context of poverty of evidence about crucial aspects of phonological competence. If children were indeed empiricist learners, they should fail to acquire phonology according to prediction 1. The fact that they succeed shows that the empiricist hypothesis must be incorrect.

Empiricists raise two objections to this analysis. First, they contest the accuracy of the description of phonological competence provided by generative phonology. Their claim is that phonological competence is much simpler than generative phonologists make it to be. There is no need to posit different levels of representation or complex derivations to generate the phonetic representations. If this is the case, we cannot fault empiricists for failing to explain how the child acquires the generative account of phonological competence since it is not an accurate picture of what the child actually knows. To counter this objection, one need only point out that generative phonology is pretty much the only game in town when it comes to proposing a serious explanation of phonology.[48] Other hypotheses (e.g., connectionist models like Rumelhart and McClelland, 1986) offer significantly less exhaustive, often merely piece-meal, explanations of phonological facts. Until empiricists can offer a competing account of phonology that is as satisfactory as generative phonology, they have no theory of a child's competence, and no one can take seriously their explanation of how phonological acquisition proceeds.

---

[48] Some might reject the claim that generative phonology is 'the only game in town' by pointing out the development of optimality theory in phonology (e.g., Prince and Smolensky, 2003). I do not see this as undermining my point. Optimality theory can be described as the most recent evolution of the research program put together by Halle, Chomsky and others during the early days of generative phonology. In the same way that the theory of UG has evolved from the 'standard theory' to the minimalist program, phonology is also undergoing changes. Optimality theory builds on generative phonology and takes over some of its central tenets (e.g., innate and universal constraints) but adopts a new vision of computation. Optimality theory is definitely not a return to the old empiricist paradigm. Prince and Smolensky, two of the most important contributors to optimality theory, recognize the filiations between their research program and generative phonology. They write: "Generative phonology aims to construct a predictive theory of natural language sound systems, rooted in a finely-detailed account of the principles defining linguistic representations and the possible relations between them. *Within these broad goals* [my emphasis], optimality theory develops in the context of specific empirical theses about the way phonological systems are organized". (2003, 1)

The second objection is even less threatening than the first. Empiricists point out that since scientists are capable of discovering the principles governing phonology by means of induction, there is no reason to think that a child, using induction, would not be able to do the same. This argument is really a red herring. To assimilate the child's acquisition process to the scientists' activity shows a gross ignorance of the crucial differences that distinguish both activities. They differ in at least four aspects. The first is the time frame. The child acquires full phonological competence before the age of 4. Phonology as a science is a slow endeavor. After long years of work by top-flight linguists (Sapir, Jacobson, etc), the first systematic account of phonological competence was offered by Chomsky and Halle (1968). Since then, constant work has sought to improve and extend the framework they proposed. The second difference is the data used. The child acquires her phonological competence solely on the basis of evidence found in her immediate environment. This is not the case for scientists who make use of a much wider selection of evidence. For example, they carry out sophisticated experiments to shed some lights on hard to grasp features of phonological competence. They look at cross-cultural data to discover phonological properties that are not language specific. There are many other kinds of evidence that scientists rely on that are not accessible to the child. While acquisition of phonology is essentially automatic and requires no conscious involvement on the child's part, it is the opposite for scientists who must consciously expand considerable cognitive effort to make even the smallest advance in understanding phonological competence. This is a third difference. Phonology as a science is an incredibly demanding intellectual enterprise that requires arduous theoretical education, rigorous analytical thinking, commitment and significant talent. Every child, whatever her intelligence, education, or interest, acquires phonology without effort. Finally, when empiricists compare children and scientists they beg one fundamental question. Before a child can engage in testing hypotheses about phonological principles, she needs to acquire the concepts by means of which she can formulate the hypotheses to be tested. The problem of acquisition is to explain how children come to know concepts in the first place. Scientists are in a different predicament altogether. They already have sophisticated concepts that they can use to build hypotheses. They also have the capacity to generate new theoretical concepts when they face the need.

When two cognitive enterprises are so different, it is absurd to assimilate them. Yet this is what empiricists do when they push the 'child as scientist' analogy. Empiricists do not limit their use of the 'child as scientist' hypothesis to the explanation of acquisition of phonology. They offer the same story to make sense of the acquisition of syntax, morphology and semantics. But objections similar to those mentioned are relevant in all these other cases. From the fact that scientists can discover by means of induction the principles of syntax, morphology and semantics, we cannot conclude that the child is in position to do the same. I will not return to this empiricist objection when dealing with other components of linguistic competence because I take it to be definitely refuted.[49]

---

[49] Some have interpreted Chomsky's description of language acquisition in *Aspects* (1965) as supporting the 'child as proto-scientist' hypothesis. This interpretation is mistaken. While Chomsky's terminology in *Aspects* can be misleading on this issue, a close reading of this work shows that Chomsky did not think that the child tested linguistic hypotheses in a way that parallels hypothesis-testing by scientists.

Syntax

In their studies, Newport *et al*. (1977) and Gleitman, Newport and Gleitman (1984) made some surprising discoveries about the syntactic complexity of the PLE available to the language-learning child. They found that most sentences in PLE are single clause sentences.[50] They arrived at this conclusion by analyzing adult-to-child speech (henceforth, ACS).[51] Morgan (1986) provides a more precise picture of the syntactic complexity of sentences in the PLE. According to his analysis, 90% of the sentences that a child encounters are single clause or degree-0 sentences (i.e., sentences with no embedded clause). The remaining 10% is unevenly divided between degree-1 (i.e., between 6% and 11% depending on the developmental stage) and degree≥2 sentences (i.e., between 0.33% and 0.68%). Morgan extrapolates that over five years the average child encounters 3.9 million degree-0 sentences, 360 000 degree-1 sentences, and 21 000 degree≥2. Unsurprisingly, the syntactic profile of adult-to-adult speech (henceforth, AAS) is quite different. Whereas ACS is characterized by its syntactic simplicity, sentences found in AAS are typically more complex; the average number of clauses per sentence is close to 3.

The syntactic differences between ACS and AAS seem to confirm the *motherese hypothesis*, according to which adults use simplified language when talking to children. Recall that most empiricists rely heavily on the *motherese hypothesis*; the simplified language used by adults when they talk to children is supposed to make it easier for the child to bootstrap herself into language. But

[50] For a recent corroboration of these findings, see Fodor and Crowther (2002).
[51] I will address the issue of the role that could play child-child speech and overheard speech in language acquisition later.

contrary to what empiricists argue, the heavy bias towards degree-0 sentences in the PLE does not facilitate language acquisition. It is in fact an obstacle for an empiricist learner. Induction over degree-0 sentences provides no information on how to construct degree≥1 sentences because single clause sentences do not exhibit the syntactic features of complex sentences. If the child were really an empiricist learner, she would miss crucial information necessary to acquire the correct and complete grammar of her target language. Fodor and Crowther (2002, 113) give examples of some aspects of syntax the child would fail to learn:

- relative clause gaps
- the complements of subordinating adverbs
- the legitimacy of long-distance wh-movement
- extraposition of complement clauses
- patterns of empty categories in purpose clauses or various infinitival complements
- relative pronoun deletion

While it is true that there are some degree≥1 sentences in the PLE, they cannot account for the acquisition of the principles governing complex sentences. Indeed, the percentage of degree≥1 is so small, especially the degree≥2 sentences, that an inductive learner will most probably not pick them up reliably. In other words, degree≥1 sentences in the PLE do not meet the accessibility requirement. Despite the dearth of degree≥1 sentences, children have no difficulty mastering the syntax of multi-clause sentences, which is contrary to prediction 1. Interestingly, there is no benefit gained from a higher percentage of complex sentences in the PLE. In fact, some studies show that it might impede language acquisition (Nelson, Carskadden and Bonvillain, 1973). Both conclusions fly in the face of prediction 2. Because degree≥1 sentences contain more syntactic information, more of these should facilitate the acquisition of syntax according to the empiricist model.[52]

Some have argued that this analysis of the PLE's syntactic diversity it is inaccurate. Pullum & Scholz (2002) claim that the PLE offers a much more representative cross-section of the various syntactic structures of language. Complex sentences abound and are relatively more frequent than Morgan (1986) recognizes, which gives the child plenty of opportunities to acquire the grammar governing the target language by induction. Pullum's and Scholz's objection can be quickly dismissed by looking at the methodology and the data upon which it rests. Unlike the studies I have quoted from, Pullum and Scholz do not reach their conclusion after *rigorous* analysis of the linguistic evidence available to actual children. Instead, they rely on skewed and inappropriate sources. Their first source is a partial analysis of CHILDES data. As Legate and Yang (2002) show, some of Pullum's and Scholz's conclusions are based on the analysis of one transcript file out of the 56 that make the Nina corpus. When the entire Nina corpus is considered, which is the methodologically proper way to proceed, Pullum's and Scholz's claim about the higher relative frequency of complex sentences proves to be false. The second source Pullum and Scholz rely on is a corpus analysis based on the *Wall Street Journal*. According to them, there is no reason to think that *WSJ* articles do not offer a representative picture of the

---

[52] Processing considerations can help explain the lack of positive effects, and even the negative consequences, of a higher percentage of degree≥1 sentences in the PLE. Because of constraints placed on memory and processing capacity, it is possible that the child cannot process degree≥1 sentences efficiently. As a result, she cannot benefit from the information found in these complex sentences. This offers no solace to empiricists however. If the child cannot successfully process complex sentences, it just makes the question of how she acquires the knowledge needed to build such sentences even more pressing for empiricists.

syntactic diversity the typical child can find in her environment. Since their analysis reveal (unsurprisingly) that complex sentences are frequent in *WSJ* articles, they infer that complex sentences must be equally frequent in the PLE, which refutes the findings of Gleitman, Newport, Gleitman (1984) and Morgan (1986). The problem here should be obvious. Adults do not talk to children like *WSJ* journalists write. Not only does common sense tell us that, but studies of ACS also bear this out. Pullum's and Scholz's argument is a non sequitur, which does not undermine in anyway the picture of PLE presented above.

Another objection that empiricists have raised is that the analysis of the PLE offered by Gleitman, Newport, Gleitman (1984) and Morgan (1986) leaves out a crucial source of information available to the child, namely adult-to-adult speech (AAS). Indeed, the child is not limited to ACS to infer the rules of syntax; she can also analyze the AAS she overhears. AAS is typically syntactically more complex and offers information that is absent from ACS. This argument is not really convincing, despite what empiricists would want us to believe. There are three problems with it. The first is the assumption that all children have access to substantial amount of AAS. This is not true for all children, as we will see below. Some children are raised in environments where they have little access to AAS. Given the universality requirement, the information provided by AAS cannot be necessary for language acquisition. The second problem is that it is not clear that the young children can process complex sentences and assimilate the information they contain because of cognitive constraints. Lastly, AAS does not provide evidence in sufficient quantity for all syntactic principles that the child ends up mastering. For example, questions with multiple embedded clauses are not frequent in AAS. Adults rarely say things like “Where did the student who went to McGill University, which is an English institution, which is in Montreal decide to go after getting his degree?” The low frequency of such constructions in AAS means that the child as little opportunity to analyze them to discover the syntactic principles that structure them.

Morphology

The child’s PLE is equally unrepresentative when it comes to principles of morphology. From very early on, children master morphological operations like affixation and compounding. Gordon (1986) studies a specific aspect of this competence, namely the production of compound expressions like “rat-infested”, “mice-eater”, “clothes-basket” and the like by children. English speakers have very precise intuitions about these constructions. For example, “rats-infested” is judged incorrect, while “mice-infested” is perfectly acceptable. In one case the plural form is allowed in the compound, while in the other it is deemed unacceptable. Obviously, it cannot be semantic considerations that motivate this difference in assessment, since both compounds have essentially the same meaning. According to Gordon, the most plausible explanation for this phenomenon is that affixation and compounding rules have a precise order of application. He argues that word formation operates in three stages. At stage 1, a root can receive so-called primary affixes (e.g., +ian, +ous, +ion). It is also at this stage that words with irregular plural forms are inflected (e.g., mouse-mice). Stage 2 is where secondary affixes (#er, #ism, #ness) are added to the root or stem. Compounding also takes place at stage 2. Regular inflections like (e.g., -s,

-ed, -ing) are attached to stems at stage 3. The order of stages is strict. Stage 3 operations always follow stage 1 and stage 2 operations, and stage 2 operations are always posterior to stage 1 operations. The order of affixation and compounding operations prevents the production of “rats-infested” but allows for “mice-infected”. The pluralization of “mouse” into “mice” is done at stage 1 because “mouse” as an irregular plural form. “Mice” is therefore available for compounding with “infested”, which takes place at stage 2. The pluralization of “rat” into “rats” is a stage 3 operation because “rat” has a regular plural form. Since compounding operates at stage 2, “rat” but not “rats” is available. Hence, “rat-infested” but not “rats-infested” is produced.[53] The hypothesis that morpholexical operations are strictly ordered explains other intuitions speakers share about the well-formedness of words. For example, it accounts for why “Darwinian”, “Darwinism”, “Darwinianism” are all correct modifications of “Darwin”, while “Darwinismian” is not.

To be able to discover inductively both these morphological rules and the order of their application, one must have access to some relevant positive evidence. With respect to plural compounds, Gordon demonstrates that they are infrequent in the child’s PLE. Furthermore, examples of compounds with irregular plurals as their non-head constituents are virtually absent from the PLE. Therefore, we cannot expect an empiricist learner who relies on induction alone to discover that irregular plurals, but not regular plurals, can be included in compounds. A fortiori, she cannot possibly find out that the behavior of plurals in

[53] Inflectional rules at stage 3 cannot operate inside compound words. Once produced a compound is an atomic unit for subsequent morpholexical rules.

compounds is the consequence of more general principles that govern affixation and morphology. Despite the PLE's impoverishment, children have no difficulty mastering these morphological competences. Here again we have a case that contradicts prediction 1.

Semantics

Just as the PLE proved unrepresentative of the principles of phonology, syntax, and morphology, the same holds with respect to semantic competence. Empiricists argue that utterance-sensory experience correlations and ostensive definitions provide the initial data on the basis of which meanings are acquired. Bloom (1999) mentions a number of studies (Collins, 1977; Harris, Jones, Grant, 1983) that show that, when a child is present, adults tend to use words that refer to what the child is attending. This is true in roughly 70% of cases. Other studies reveal that adults engage in naming games, where they point and name objects for the child (Heath, 1983). It appears, then, that the child does have access to some utterance-sensory experience correlations and ostensive definitions to help her discover meanings. While these findings can be interpreted as supporting the empiricist hypothesis, a closer look reveals some important caveats. What these studies show is that in 70% of cases words used by parents in presence of the child refer to what she is attending, and not that adults name 70% of what the child is attending. In fact, labels provided by adults cover only a very small portion of what the child attends. This is to be expected since, as Gleitman (1990, 21) points out, "the caretaker speech is not a running commentary on scenes and events in view" of the child. Adults only offer labels for what they consider important and interesting from their own perspective and from their understanding of the child's interests. For example, while it is likely that adults will utter the word "dog" when the child is looking at Fido, it is unlikely that they will say "rim" when she is staring at the coffee cup's rim. Over and above judgments of importance and interest, there are probably many other biases that contribute to skew the adults' labeling practice. Common sense leads us to think that adults will label mainly middle-sized objects and salient properties. They will rarely talk about less tangible 'things' like events and abstract entities. Studies tend to confirm these commonsense intuitions. According to Brown (1958)[54], basic-level terms are the most frequent category of nouns used by adults when speaking to children. These terms usually denote objects that are common in the environment (e.g., dog, car, book), informative and involve little abstraction. Basic-level terms are opposed to superordinate-level terms and subordinate-level terms. The former are more abstract and encompassing (e.g., "animal", "vehicle", "publication"), while the latter more specific and have more restricted reference sets (e.g., "Chihuahua", "Buick", "*The Republic*"). Because adults tend to use primarily basic-level terms, this means that there is a whole array of nouns to which the child is less exposed.[55] In Gleitman (1990), we learn also that adults are less likely to name actions than things. They rarely say "This is *bringing*" or "This is *putting*". Action words is another category for which the child does not benefit from reliable ostensive definitions.

---

[54] For a recent study on the parental bias in favor of basic-level terms when interacting with children, see Hall (1994).

[55] Despite the predominance of basic-level terms in the PLE, children language production is not biased towards basic-level terms, which is contrary to the empiricist prediction. According to Nelson, Hampton and Shaw (1993), only about half the nouns used by children are basic-level terms.

Thus, there are many linguistic expressions for which adults are *unlikely* to provide cues such utterance-sensory experience correlations and ostensive definitions to help the child elucidate their meaning. But then there are those linguistic expressions for which there can be no such cues because these expressions have no observable referential counterpart. When we think about it, we realize that a substantial number of lexical items fall into this category. Here is a partial list:

- determiners (e.g., “the”, “a”)
- prepositions (e.g., “at”, “for”)
- mental verbs (e.g., “think”, “wonder”)
- fictional entities (e.g., “boogeyman”, “Martian”)
- psychological concepts (e.g., “intention”, “desire”)
- abstract concepts (e.g., “justice”, “truth”)

To this list, we must also add words whose perceptible referential counterparts, while they exist, are inaccessible to the child (e.g., “bacteria”) or not found in her environment (e.g., “abyss”). The absence of perceptible targets for a larger number (if not most) words and utterances should not surprise us. It is an essential feature of our concepts. Indeed, what makes language truly useful is that it allows us to express thoughts that go beyond what is directly perceptible ‘here and now’. If language was strictly iconic, both its expressive power and its usefulness would be greatly reduced (Gleitman, 1990).

But in cases where robust utterance-sensory impression correlations and ostensive definitions are available, do they provide sufficient information for the successful acquisition of concepts? There are various reasons that show that they do not. First, there is the issue of the representativeness of the referential set. For example, we can imagine that the child hears the word “house” mainly when attending to her own house, and those found in her neighborhood. These are most likely similar in architecture, building material, etc. For a child born in a classic North-American suburb, a house is typically a one or two-stories bungalow with a yard and a driveway. But clearly this provides limited and skewed information to generalize the meaning of “house”. Indeed, a house need not have any of the observable properties exhibited by this particular group of houses. The second problem is more serious. In most cases, many aspects of the meaning of words are not readily generalizable from the observable properties of their referents when they happen to have some. The word “home” is a good example of this. A home is a dwelling place for some beings, typically humans but not exclusively so (e.g., my doll’s home, my dog’s home). This does not fully capture the meaning of “home”, because something can meet this basic criterion and still fail to be a home (e.g., a cottage, a shelter). In addition to this functional aspect, there is a crucial intentional component to the meaning of “home”. A structure becomes a home to someone only if it is recognized as such by the person. While I might have lived in a building for ten years, it might still not be my ‘home’ because I do not consider it as such. Observable properties do not provide a reliable source of information to discover this last aspect of the meaning of “home”. The word “dog” can be used to make the same argument. Like “home”, “dog” seems to be a word whose meaning is well suited to be acquired by means of ostensive definitions and utterance-sensory impression correlations. Dogs are middle-sized objects with relatively well-defined and contrasting perceptual properties that should facilitate meaning acquisition. On the basis of dog encounters, it seems plausible that the child will infer that “dog” stands for something like [middle-sized, four-legged, self-moving, potentially barking living entity]. But even if observable properties are sufficient to infer this, it still falls short of the full meaning of “dog”. “Dog”, like “home” and most words in the lexicon, has some fairly abstract semantic features that are perceptually invisible but which are mastered by the child early on. For instance, inherent to the meaning of “dog” is the concept of underlying essence shared by all dogs and which is the condition of species membership (Atran, 1990; Keil, 1989; Medin & Ortony, 1989). To be a dog, an entity must possess this intangible property that is the necessary and sufficient criterion for doghood. This is the crucial factor that overrides perceptual or behavioral considerations (Keil, 1989). This aspect of the semantics of “dog”, and of all biological kind words in fact, is not one that can be inferred from observable properties. No amount of dog occurrences will enable a child to learn this.

Verbal definitions and explanations are supposed to provide some of the information that cannot be gathered from utterance-sensory impression correlations and ostensive definitions. However, when we analyze ACS, we discover that verbal definitions and explanations with the function of elucidating the meaning of linguistic expressions are not frequently produced by adults (Gleitman, 1990). Thus, these cannot play an essential or even substantial role in the acquisition of semantic knowledge. But even in the rare cases where a definition or explanation is supplied, it will never fully specify the target expression’s meaning. Asked for the definition of “book”, an adult will provide a short, idiosyncratic and incomplete statement that leaves out many crucial aspects of the word's meaning. Adults do not explain that "book" has both an abstract and concrete meaning. "Book" means both [a physical object made of pages that contain written inscriptions], but also [the sum of information that is contained in such physical object]. This is not the kind of information that adults give when the child asks for a definition. The problem is not that adults do not know these facts. They do, but this semantic knowledge is usually implicit or considered so obvious that adults do not see the purpose of mentioning it. Notice that the very same shortcomings that mar definitions offered by the average language speaker also apply to definitions found in the most comprehensive dictionary. Dictionary definitions do not fully specify the meaning of words (Chomsky, 1988, 1997). Not only do they assume a lot of prior semantic knowledge on the part of the reader, but they only provide partial 'cues' about meanings. When we use a dictionary, we actually *reconstruct* meanings based on impoverished information. The issue here is not merely the lack of thoroughness on the part of lexicographers when they compile dictionaries; the problem runs deeper. Many philosophers (e.g., Quine, 1961; Fodor, 1998) have made the case that the meaning of most lexical items cannot be fully captured in terms of the meaning of other natural language lexical items. If this is correct, dictionary definitions necessarily fall short. A different issue is whether we can rely on how a word is used to capture its meaning. The idea that a dictionary could provide us with meaning rests on the assumption that 'meaning is use'. Like other forms of semantic externalism, I will argue that the use theory of meaning is hopeless (see Part 2). Even assuming that 'meaning is use', the fact that language use is essentially creative (i.e., there is an unbounded number of acceptable uses for each lexical item), makes the creation of a dictionary that fully describes the use of words impossible.[56]

The last source of evidence the child can rely on, according to empiricists, comes from the analysis of how other speakers use words in linguistic exchanges (e.g., the inferences it justifies, the commitments it entails, etc.). The claim is that the child is raised in an environment that is rich in linguistic interactions giving her plenty of data on the basis of which she can discover the correct ways to use words. For most empiricists, the bulk of the semantic knowledge acquired by the child comes from this source of information, and it fills the gaps left by the other sources of evidence examined so far.

For all its commonsense appeal, this hypothesis proves untenable once we look at it carefully. In order for the child to even stand a chance of inferring the meaning of a given word by analyzing how it is used in linguistic exchanges, she must have access to a sufficiently wide variety of examples of use in order for its meaning to come into focus. An analysis of ACS reveals that these essential conditions are not met. During the years when the child acquires most of her linguistic competence, ACS is limited in breadth and depth. For one, linguistic exchanges focus primarily on the 'here and now' (Gleitman, Newport, Gleitman, 1984). Adults and children talk about dogs, balls, milk and so on, but rarely about speed, mind or desire. For all these words that are not directly related to the 'here and now', linguistic interactions offer little data to support semantic acquisition. But even in the case of words directly pertaining to the 'here and now', we can

[56] It might be possible however to create a different type of dictionary where the meaning of a lexical item is defined in terms of the speaker's internal conceptual resources.

question whether linguistic interactions can really support meaning acquisition. We know from studies (Gleitman, Newport, Gleitman, 1984) that questions and commands make up a large portion of ACS. The child is exposed to most words only in these communicative contexts. Empiricists do not consider this situation to be worrisome. As they see it, questions and commands provide excellent contexts for meaning acquisition because they usually involve feedback on the part of adults, which can be used by the child to refine her semantic hypotheses.

This explanation, however, is riddled with problems. First, the bias towards questions and commands means that other important communicative contexts are underrepresented; this has for consequence that some semantic aspects of words that are tied to different kinds of linguistic interactions will be hard to recover by the child. Second, adults' chief goal, when they utter a question or a command, is to insure that the child understands what is asked of her, and that she answers or carries out the request adequately. For this reason, adults usually favor simplicity to achieve maximum communicative success. They leave out what they consider to be minor or superfluous details that might distract the child. But by doing this, adults also reduce the semantic information that can be extracted from these communicative contexts. If meaning acquisition is to discover the role played by a word in different linguistic exchanges, then the child benefits from linguistic exchanges that have a certain level of complexity because they provide occasions for the different aspects of the word's meaning to reveal themselves. Third, while it is true that questions and commands usually generate some feedback, it is often semantically shallow. The feedback is often little more than an acknowledgement of compliance or non-compliance (e.g., "Thank you very much!", "Great!", "No!"). But from such feedback, one cannot really work out the subtler facets of concepts with limited observable signatures.

It could be argued that the child benefits from overhearing adults talking with each other. While ACS addresses only restricted topics, AAS runs the whole gamut of topics and contexts. As a spectator to these conversations, the child can pick up the semantic information that is absent from child directed speech. There is evidence that children do indeed rely on this source of information for conceptual acquisition. For example, work by Oshima-Takane (1988, 1998) shows the positive impact of overheard speech in the acquisition of some pronouns; acquisition is noticeably faster for children that were exposed to AAS. The explanation offered is that it becomes easier for the child to discover the deictic role of pronouns and their context-dependency when she encounters them in a greater variety of communicative contexts. This study is interesting but does little to support the empiricist hypothesis. What it shows is that acquisition of pronouns is *faster* when the child has access to AAS, not that AAS is sufficient or even necessary to acquire the meaning of pronouns. Furthermore, these findings are not necessarily transferable to lexical items that are not pronouns. From a semantic perspective, pronouns are quite unique. They play a strictly deictic function. Most words typically have richly textured meanings that cannot be reduced to a deictic function. From the fact that AAS helps the child elucidate the deictic role of pronouns, we cannot conclude that it provides substantial information for the acquisition of meanings of non-pronoun lexical terms.

While AAS is unlikely to be sufficient for full meaning acquisition, it could at least fill the gaps left by the other sources of semantic information available to the child. This is unlikely. This is both the consequence of the overall paucity of the other sources of information and of the impoverished nature of the semantic information that the child can get from AAS. There are some fairly trivial points that those who argue that AAS plays a crucial role in semantic acquisition often fail to see. The first is the issue of when exactly some piece of AAS can be considered evidence for meaning acquisition. Clearly, it is not sufficient for an adult conversation to be within the child's earshot to count as semantic evidence. As pointed out before, one must be careful not to confuse *presence in the environment* and *uptake*. It is safe to say that the vast majority of AAS that is present in the child's environment is not semantic evidence simply because she does not attend to it. When adults speak together, children are not always attentive listeners; typically they focus on something else because the conversation is of little interest to them. Active listening to AAS is not a sufficient condition for it to be evidence either. The child must be able to understand it. Quite a few adult conversations, maybe the majority, do not meet this basic requirement. This might be the result of the way adults actually speak (e.g., speed, expressions used, irony) and/or the subject matter addressed. In the end, we can only expect the child to be able to analyze a fraction of the total AAS in her environment. Moreover, adults do not engage in extensive discussions on all possible topics. For example, odds are slim that the child will hear adults conversing at length about the meaning of "intention" or "mind". Finally, when AAS that is pertinent to a certain linguistic expression is accessible, it never exhausts its semantic richness. This last point follows from the very nature of human language use, namely its creative aspect.

Since Descartes, many have stressed that language use is essentially creative.[57] By ‘creative’, Descartes and others mean that language allows for the free (i.e., uncaused by forces external to the subject) expression of ideas that are both original (i.e., that have not been uttered or even thought before) and appropriate (i.e., meaningful and relevant to the context). For this to be possible, lexical items must have a range of acceptable use that is essentially open-ended. If the acceptable use of concepts were strictly delineated, it would be impossible to use language in a genuinely creative fashion (i.e., metaphors).

This property of language use bears directly on the issue of the comprehensiveness of the semantic evidence available to the child. By definition, the child only has access to a finite number of sentences containing any given word. Furthermore, she is only exposed, for each word, to a finite number of ways that it can be used appropriately. But acceptable uses of a word are neither constrained nor reducible to prior uses. It is not even clear that various uses of a given word are analogically related in any significant way. Consider these two statements in which the word “house” is used:

(29) This building is John’s house.

(30) Language is the house we live in.[58]

The typical English speaker is bound to encounter statements similar to (29) in much greater number than statements similar to (30). Given the typical use of the word “house” that we usually come across, it is unclear that one could, by generalization or other means, know that “house” can also be used in a statement

[57] See Chomsky (2002) for an historical overview of the creative aspect of language use.
[58] This is the English title of an Icelandic movie.

like (30). In most cases, "house" is used to talk about a non-biological physical entity (i.e, a building) in which a living physical entity (i.e, John) inhabits. The relationship that exists between John and the building *qua* "house" is, among other things, physical (i.e., to inhabit it to 'be inside'). We find none of this in (30). Language is not a physical entity, but something quite abstract. The relationship between language and us is clearly not physical, but strictly conceptual. We cannot expect anyone (especially a young child) to learn that "house" can be used as in (30) from cases like (29). Talk of analogy is empty unless a serious theory of analogical thinking is put forward. The conclusion is that that the PLE is massively non-comprehensive with respect to semantics, but this does not cause any difficulties to the child in her attempt to acquire language. Prediction 1 is once again falsified.

Comprehensiveness: cross-cultural considerations

Most of the data discussed so far comes from studies of children from middle class American families. According to Heath (1983) and Bavin (1995), a distinctive characteristic of middle class American adults is that they talk extensively to children. They play language games, ask questions, and provide ostensive definitions. Adults believe that sustained linguistic interaction is required for language acquisition to succeed. In other cultural and social groups, linguistic interaction between adults and children is often radically different. Looking at cross-cultural differences sheds some light on another dimension of the PLE's lack of comprehensiveness.

Heath (1983) discusses the childrearing practices of a lower class black community in the southeast of the United States. In this community, children are not seen as potential communication partners. As a result, parents and other members of the language community rarely talk to them directly nor do they offer ostensive definitions. The bulk of the linguistic evidence the typical child has access to is indirect and comes from the adults interacting amongst themselves (i.e., AAS). In the Kaluli tribe from the Grand Papuan Plateau, linguistic education offered by adults limits itself to teaching assertive language (e.g., teasing, shaming, requesting) by providing model utterances that children are asked to repeat. Kaluli adults never teach object names to children (Schieffelin, 1985 in Bloom, 2000). Closer to home, Crago *et al.* (1997) analyzed similar patterns of linguistic interactions in Inuit families of Northern Québec. As a rule, Inuit children spend most of their time with siblings their age, and most linguistic interactions happen in the context of games among themselves. These exchanges are often phonologically and grammatically inchoate. When there is linguistic interaction between adults and children, it is rather limited. It involves mostly training children to greet older members of the community. Mini-discourses, question-answer games, etc. are unusual. In fact, Crago *et al.* (1997) notice that older Inuit mothers and caretakers are unlikely to engage in activities that involve language with children under their supervision. They do not encourage children to speak and many activities occur in silence. It is only when adults talk amongst themselves while they are present that children have access to more substantial linguistic evidence. Bavin (1995) describes similar patterns of adult-child interaction in the K'iche' Maya community, the Western Samoa community and the Warlpiri community.

These cross-cultural findings are very significant. In many societies, the child's PLE is less comprehensive than the PLE of the average middle-class North-American child. If the empiricist hypothesis were accurate, we would expect children raised in these communities to have a harder time acquiring language than their North-American counterparts. But this is not the case. When we compare North-American children to children from these societies, there is no noticeable delay in linguistic development and no linguistic deficiencies. This proves that language acquisition is mostly impervious to variations in adult-child linguistic interaction.[59]

Pidgin-speaking communities offer another perspective on the topic of comprehensiveness. In these communities, children are able to acquire a fully operational language despite being raised in an environment where the natural language they end up acquiring is not even spoken. Even more surprising are cases where children create a Creole without having access to a natural language (Kegl *et al.*, 1999).

In certain historical contexts, individuals who did not share a common language have had to learn to communicate effectively in order to survive. This was often the case, for instance, of slaves on plantations. Coming from diverse origins and often purposefully mixed to ensure that they did not speak the same language, these individuals nonetheless found ways to communicate linguistically.

---

[59] Obviously, this undermines the hypothesis, favored by many philosophers, according to which language acquisition requires *Motherese*.

Initially, they communicated using what is usually called *pidgin*. A pidgin is a simplified linguistic code built from elements of the native languages spoken by the members of the new community. Rapidly, often in one generation (Bickerton, 1999), the pidgin makes way to a *Creole*, which is a fully specified natural language. Children exposed to pidgin in their youth generate a new language that is in many ways radically different from the ambient pidgin.

The passage from pidgin to Creole provides a good example of how language acquisition can take place even when the PLE available is severely impoverished. Indeed, pidgin lacks many of the phonological, morphological, syntactical and semantic properties that are characteristic of natural languages, and that are found in the newly created Creole. For example, the phonology of pidgin is highly variable, due to the interference of speakers' native language. As a result, there is not a stable phonological target that children exposed to pidgin can internalize. The syntax of pidgin is essentially non-existent (Bickerton, 1999). There is no genuine grammatical structure to utterances. Tense, modality markers, aspect markers, and embedded structures are absent. Ellipsis of arguments and verbs are frequent. To give a taste of the extremely impoverished nature of pidgin 'syntax', consider the following examples (from Bickerton, 1999 and Jackendoff, 1994):

(31) I carriage horse too fast clock?

(32) too-much money me think catch though.

Pidgin's semantic expressiveness is also very poor. This is the due to the combination of two factors. On the one hand, pidgin is created to allow for communication in very specific contexts, mainly work and business (Degraff, 1999). As a result, it rarely provides the required resources to express thoughts that go beyond these contexts. On the other hand, the poverty of Pidgin's syntactic apparatus makes it difficult to express complex ideas. For example, the lack of tense and modality restricts the semantic scope of pidgin.

Creole exhibits none of the shortcomings of pidgin. It possesses a fully defined and consistent phonology. It has all the syntactic trappings of a natural language like tense, modality, etc. Finally, Creole is not limited in its expressive power. If children were really empiricist learners, they would merely reproduce the pidgin found in their environment with its inherent limitations. But this is not what happens. The children's feat cannot be explained in terms of exceptional generalizing capabilities either. Many features of Creole cannot be inferred by induction from pidgin because they are simply absent from it.

Some have insisted that this account leaves out the influence of the parents' native language in the creation of Creole. The phonological, syntactic and semantic elements absent from pidgin and found in Creole could well have been transferred from the parents' native language. Yet, the analysis of many Creoles reveals that they do not borrow syntactic elements from the languages natively spoken by the members of the community. For instance, there are cases where all languages represented in the community have a Subject-Verb-Object structure, but the Creole exhibits Subject-Object-Verb order (Jackendoff, 1994). Second, while Creole often borrows from the phonology of the languages present in the community, in most cases there are substantial modifications in phonological features. These features are not simply the result of averaging out of the characteristics of the different languages spoken, but are often truly emergent and original.

There is, however, a stronger rebuttal to the claim that Creole's original linguistic features are simply transferred from adults' native languages. It comes from studies of sign language acquisition by deaf children who were raised in contexts where they only had access to *homesign*, the sign language equivalent of pidgin. For example, Kegl *et al*. (1999) have studied a group of deaf children raised in Nicaraguan institutions where the only means of communication used and taught was a rudimentary homesign. Just as pidgin, this homesign lacks most features associated with natural language like consistent phonology, elaborate syntax, and wide expressive scope. The crucial difference between the situation of children learning Creole from pidgin and the children studied by Kegl *et al*. is that the latter did not have access to the adults' native languages.

If the access to adults' native languages plays a crucial role in the acquisition of Creole, we would expect children who only have access to homesign to fail in the acquisition of a full-fledged sign language (i.e., a natural language). Yet, studies by Kegl *et al*. show the opposite. The Nicaraguan children do indeed acquire a fully functional natural sign language with all the standard features of a natural language despite the impoverishment of the PLE they have access to. In fact, Kegl *et al*. show that the crucial factor determining whether a child will acquire native fluency in sign language is the age of initial exposure to some form of sign communication, whether homesign or natural sign language.

I want to conclude this section on comprehensiveness by examining one last case. It differs from those we have considered so far to the extent that the cause of the PLE's impoverishment is the child's own perceptual deficiency. A blind child, because of her impairment, does not have access to the same range of perceptual information as a sighted child. This has some obvious consequences on the nature of the PLE available for language acquisition. Whereas the sighted child can benefit from visual cues to help her figure out the features of the target language, the blind child does not. The evidence that is inaccessible ranges from visual perceptual properties (e.g., red visual perception), utterance-visual property correlations (e.g., "The book is on the table" with the visual perception of a book on a table), ostensive definitions (e.g., "*This* is red"), and conversational visual cues (e.g., gaze, facial expressions). There is no evidence that information coming from other perceptual modalities can fully replace the information vision normally provides. Not only is a blind child's evidential basis significantly impoverished, it is also skewed towards perceptual evidence that usually plays a peripheral role in language acquisition, namely haptic evidence. In this situation, the empiricist hypothesis predicts (Locke, 1975, Book II, chapter VII) substantial differences in the linguistic development and the language acquired by the blind child. In addition to slower language acquisition, it should prove very difficult or even impossible for the blind child to acquire words whose meanings are closely connected to the visual modality (e.g., color terms, "to see", "to look"). Furthermore, the blind child's semantic competence should show some important peculiarities. Meaning of words should exhibit the important role played by haptic evidence. Put differently, while a blind child might use the same phonetic labels as sighted speakers, the meaning she associates to these should be different to some degree.

In their seminal study, Landau and Gleitman (1985, see also Gleitman, 1990) rebut the empiricist predictions about language acquisition by blind children. *Contra* the empiricists, the linguistic development of blind children does not differ significantly from that of sighted children. On average, developmental milestones are reached at the same time in both groups, and being blind does not correlate with notable linguistic deficiencies. For instance, blind children do not fail or have special difficulties acquiring words that pertain to vision ("to look") or essentially visual properties (e.g., "red"). While there are aspects of the meaning of these words they do not possess (e.g., the qualitative aspect associated to color words), blind children have very much the same concepts as sighted individuals, which is incredibly surprising given that they have access to no visual information.

Correctness

Being a fluent speaker does not entail that one never makes mistakes when speaking. Our linguistic production exhibits phonological mishaps, syntactical errors and semantic improprieties. More often then not, these are not symptoms of deficient linguistic competence. Instead, they are caused by various factors affecting our linguistic performance. For example, distractions (e.g., being interrupted, thinking about something else while talking, etc.) can lead to incomplete sentences, incorrect word choice or failure to affix the right inflectional morpheme. Certain words when they are stringed together become difficult to pronounce properly because of their respective phonetic properties (e.g., "Shall she sell seashells?"). The presence of utterances that do not respect the principles of phonology, morphology, syntax and semantics obviously contributes to the impoverishment of the child's PLE, and constitutes a further obstacle to inductive language acquisition.

While errors are present in the PLE, they are not pervasive. However, there are studies of language acquisition in contexts where errors are omnipresent. Surprisingly, children learning their first language in such situations often succeed in attainting full linguistic competence. This proves that language acquisition is to a large extent impervious to errors in the PLE, which is unexpected if children are empiricist learners. A good example of language acquisition in spite of substantial PLE error rate is sign language acquisition by children who do not have access to native or fluent signers.

Children acquiring sign language often find themselves in situations where their main caregivers are not fluent speakers of sign language (henceforth, SL). According to studies (Newport, 1999), only 5% of deaf children are born from parents who are native speakers of SL. Most deaf children are born from hearing parents who are late learners of SL and who never achieve native fluency. A characteristic feature of non-native linguistic competence is a much higher rate of errors, especially with regards to morphology, syntax and phonetics. Newport analyzes the speech production a deaf child's parents who are both late learners of SL to see what errors they make when they communicate using SL. Her conclusion is that their signing is often syntactically and morphologically deficient. For example, when using verbs they will often (between 25% and 60%

of occasions) use incorrect morphemes or simply leave them out. In fact, Newport argues that in many cases morpheme use does not follow any systematic rule but are simply employed probabilistically. What makes Newport's study especially interesting is the fact that the child's contact with SL was solely through his parents. He did not interact with other SL speakers (either fluent or non-fluent). As such, he could only rely on his parents' severely corrupted sign production in order to acquire SL. Nonetheless, the child succeeded in attaining near native competence in SL, competence that far surpasses his parents'. Focusing on morphology, while his parents' use of certain morphemes exhibits between 35% and 40% error rate, the child achieves native competence in their use. He was able to reach almost native competence for other morphemes for which his parents have over 60% error rate.[60]

The child's success shows the resilience of the language acquisition process even when taking place in less than optimal contexts. It seems that, when acquiring language, the child is able to filter out most of the errors found in the PLE and successfully internalize the correct principles governing the target language. This is contrary to the empiricist claim that the knowledge acquired is basically a reflection of the evidence found in the environment.

Ambiguity

The grammatical sentences in the PLE provide the positive evidence the child has access to in order to acquire the syntactic principles of language. It is from the analysis of these sentences that the child is expected to discover the rules

[60] According to Newport (1999), critical period effect rather that poverty of evidence best explains the failure to reach full native competence.

that generate all and only the grammatical sentences of the target language. The problem for an empiricist learner who comes to this task with nothing more than a capacity for induction is that the positive evidence is fundamentally ambiguous. Induction over the positive evidence generates an extremely large number of different hypotheses that are all equally consistent with the data set, but incorrect. Based on positive evidence alone, an empiricist child would be unable to determine which of the many hypotheses is the correct one since they are all equally supported by the positive evidence! As we will see shortly, the problem here, as Freidin (1991) points out, is not one of insufficient positive evidence. No matter the amount of positive evidence available, the problem would still persist. The cause of the problem lies in the nature of the positive evidence and of the empiricist learning model. The following canonical example (Chomsky, 1986; Freidin, 1991; Lasnik & Uriagereka, 2002) will make this clear.

In English we can generate question sentences by transforming declarative sentences like (33) into sentences like (34):

(33) Philosophy is complicated.

(34) Is philosophy complicated?

Induction over a set of sentences like (33) and (34) yields a number of hypotheses about the transformation that must be operated to generate question sentences. (35) and (36) are consistent with the evidence set:

(35) Front the first auxiliary.

(36) Front the auxiliary in the main clause.

(36) is the correct generalization to make in English, while (35) is incorrect despite being consistent with (34). The empiricist claim is that given more

positive evidence, an empiricist learner will exclude principles like (35) and see that (36) is the correct rule to adopt. For example, if (37) is part of the PLE, this contradicts (35) and supports (36):

(37) Is the book that is on the shelf interesting?

While it is true that (36) but not (35) is consistent with (37), there are many other generalizations that are equally consistent with (37) and (34). Lasnik and Uriagereka (2002) provide some examples.

(38) Front any auxiliary.

(39) Front any finite auxiliary.

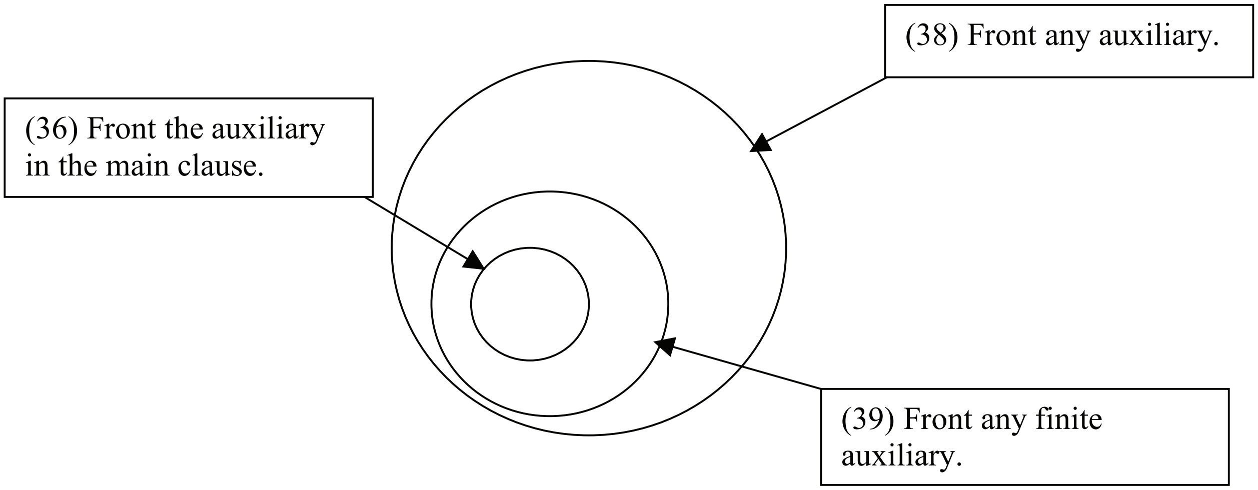
Indeed, if we look at the possible outputs of (38) and (39), sentences like (34) and (37) are present. There are obviously ungrammatical sentences like (40) that are in the extension of (38) and (39), but that is not the issue here. The issue is whether an empiricist learner is equally justified in adopting (38), (39) or (36) by unconstrained induction over sentences like (34), and (37). Clearly, this is the case.

(40) Is the book that on the shelf is interesting?

One can represent graphically the challenge faced by a child who must acquire language by induction alone. In figure (I), the extension of each grammatical rule is given by the circle it is connected to. The problem is that the extension of (36) is a subset of the extension of (39), while the extension of both (36) and (39) is a subset of the output domain of (38).[61]

[61] This problem is sometimes called the 'subset problem' in linguistic literature.

Figure (I)



Adding more complex examples (e.g., Is the book that is on the shelf that is next to the door interesting?) coming from the extension of (36) will not solve the problem, since these sentences are equally in the extension of hypotheses (38) and (39).[62]

When confronted by this argument, empiricists often invoke notions like simplicity. In a situation where many hypotheses are compatible with the evidence, an empiricist learner will choose the simplest hypothesis. But this will not do. In most cases the correct grammatical principle that the child should infer is not the simplest. (36) is a case in point. (38) and (39) would certainly appear to be much simpler hypotheses than (36) for an unbiased empiricist learner, yet both are incorrect.[63] Furthermore, simplicity is necessarily defined in terms of a criterion. For example, simplicity can be stated in terms of computational

[62] The problem highlighted here is an example of what Goodman calls 'the new riddle of induction'.[62] In *Fact, Fiction and Forecast* (1960), he lays out its general structure. Chomsky explicitly recognizes this as can be seen in Piattelli-Palmarini (ed.) (1980).

[63] As Laurence and Margolis (2001) correctly point out, the foundational principles of grammar, of which (36) is not part, are even more abstract than the various hypotheses used in this discussion.

efficiency (i.e., simpler is what allows for faster computation), theoretical economy (i.e., simpler means greater parsimony with respect to theoretical posits) or a number of other factors. Depending on the criterion that one chooses, judgment about simplicity varies. A true empiricist learner, one that has access only to a domain-general inductive mechanism, does not have a predetermined criterion for simplicity judgment. One could argue that this objection rests on an overly restrictive interpretation of the empiricist position. Indeed, the existence of an innate criterion for simplicity is not inconsistent *per se* with empiricism (viz. Quine's 'similarity space'). Recall that serious empiricists recognize the necessity of some innate machinery. What they reject, however, is the innateness of elaborate and domain-specific concepts and mechanisms. The simplicity criterion could well be domain-general, that is useful for language acquisition and other cognitive tasks. Such a concession would be quite innocuous from an empiricist's perspective. The problem with this proposal is that it does not work. When we consider the PLE and the linguistic knowledge that the child acquires from it, it becomes clear that a thinly specified and domain-general criterion of simplicity will not suffice. The only way for hypothesis (36) to be the simplest generalization is if the PLE is analyzed from the perspective of the essential structure of human natural language. But the innateness of such structure is something that empiricists cannot accept.

The general conclusion to be drawn from our discussion so far is that no amount of positive evidence will enable an empiricist child to reduce the number of hypotheses consistent with the positive evidence to one, which is what happens during language acquisition. This is true with respect to syntactic principles, but also phonological and morphological ones.

It is also true for semantics. With respect to meaning, some empiricists have been forthright about the ambiguity of positive evidence. Quine and Goodman come to mind here. Quine (1960) convincingly argues that the positive evidence will always support an innumerable number of semantic hypotheses. This is one of the conclusions of Quine's 'radical translation' thought experiment. The details of this experiment are well known, so I will be brief in my description. Imagine that a linguist L encounters an individual T from a lost tribe in a remote area of the planet. T speaks a language that is completely foreign to L. As a rabbit scurries through the bushes, T utters "Gavagai". L is interested in knowing what "Gavagai" means. Quine assumes that L is an empiricist learner.[64] L tackles this task by analyzing in what situations T uses "Gavagai" and tries to discover what they all have in common.[65] After much hard work, L discovers that "Gavagai" is always used in the presence of a rabbit, and she therefore concludes that "Gavagai" expresses the concept [rabbit]. Quine points out that while reasonable, L's hypothesis is not the only one that is compatible with the evidence. From the perspective of an empiricist learner, (41), (42) and (43) are equally reasonable.

(41) [rabbit parts]

(42) [rabbit stage]

[64] In fact, there is no other option for Quine.

[65] In his description of the thought experiment, Quine allows the linguist to test her semantic hypotheses by checking whether native speakers of the language assent or dissent to her use of "Gavagai". Notice that this assumes that L is able to understand the natives expressions for assent and dissent. But in a context of radical translation, this assumption is not warranted. As such, L only has access to examples of use or positive evidence.

(43) [temporal slice of a rabbit]

Even more problematic for L, according to Quine, is that there is really no way to decide between these hypotheses based on positive evidence alone. To decide between them, it is necessary to introduce other hypotheses about the semantic competence and the ontology of T (e.g., T's ontology is not one of temporal slices, etc.). But all these supplementary hypotheses are just as underdetermined by the evidence as the first; the initial problem remains. Quine also shows that the problem of indeterminacy becomes even more intractable for expressions that are not directly related to observable properties.

According to the empiricist model, the child finds herself in the same situation as linguist L. She has access to the same cognitive tools and linguistic evidence. Coming from Quine, one would think that these results would be taken seriously by empiricists. Quine's solution to the problem of radical translation is to jettison meanings altogether. But those empiricists who are not ready to follow Quine's radical solution are in a difficult position. They cannot argue that given sufficient positive evidence it is possible to overcome ambiguity. The quantity of positive evidence in no way solves the problem; this is precisely what Quine's thought experiment shows!

Negative evidence

While it might be true that positive evidence is ambiguous, empiricists argue that the child has access to negative evidence that helps her exclude incorrect hypotheses and converge on the correct ones.

Empiricists believe that a wide variety of behaviors, both linguistic and non-linguistic, play the role of negative evidence. For example, adults might explicitly correct the child using utterances like "Don't say X" or "You should say Y, not X". Cues can also be subtler. Absence of reply, demands for clarification, reformulation of the statement, and facial expressions are also considered negative evidence by empiricists. These behaviors show, if only implicitly, that something is wrong with the sentence uttered.

Many have come to doubt that negative evidence is essential to the process of language acquisition. Research shows (1) that negative evidence is not available to all children and for all aspects of linguistic competence; (2) that it is essentially ambiguous and conveys little useful information; and (3) that children often fail to assimilate negative evidence even in the most favorable conditions.

Marcus (1993) observes that negative evidence available to the child can be of one of three types: *complete*, *partial* or *noisy*. The negative evidence is said to be *complete* when a specific corrective feedback is provided in every instance when a linguistic error occurs and only when a linguistic error occurs. A context where the negative evidence would be complete is a speech community where linguistic errors, and only linguistic errors, prompt the interlocutor to utter a specific string of words like "Don't say this!". Negative evidence is *partial* when the corrective feedback follows only but not all anomalous statements. Finally, negative evidence is *noisy* when the signal used to mark errors also has other purposes. Consider, for instance, the case of a speech community where "No!" is the signal used to flag linguistically anomalous statements. While "No!" is used to draw attention to linguistic errors, it has other uses. It can follow a question (e.g., "Did you buy bread?"), and in such case it does not indicate that the speaker has made an error, linguistic or not. In other words, whether "No!" is a corrective signal depends on the context of its use.

It should be clear to all that children do not have access to complete or even partial negative evidence. Adults do not flag all linguistic errors using a behavior that is reserved to this task alone. Studies (Brown, 1973) show that adults usually do not correct or even notice most linguistic errors made by children, especially syntax errors.[66] Errors are rarely followed by meta-linguistic comments (e.g., "Don't say X!", see Howe, 1981) nor do they cause reliable negative consequences (e.g., absence of reply, recasting, etc.). On this last point, Brown and Hanlon (1970) offer some interesting data. Their analysis shows that signs of lack of comprehension on the part of adults are just as likely to follow a grammatical statement as an ungrammatical one. Moreover, grammatical and ungrammatical statements are just as likely to lead to a reply exhibiting signs of comprehension on the part of adults. Hirsh-Pasek, Treiman and Schneiderman (1984) conclude that the grammaticality of the utterance does not reliably correlate with interlocutor approval. While grammatical utterances are more likely in a ratio of 3 to 1 to generate approval than ungrammatical utterances, it appears also that grammatical utterances when compared to ungrammatical utterances are disapproved in a ratio of 5 to 1. In short, comprehension or approval does not track grammaticality.

[66] Adults seem to be mainly attuned to the truth-value of statements made by children. As such, adults are somewhat more mindful of semantic errors. On this issue, see Brown and Hanlon (1970).

Hence, adults are not very reliable nor systematic when it comes to corrective feedback. Thus, the negative evidence children have access to is noisy. This creates serious difficulties for the child if she is an empiricist learner. One difficulty is determining when a given behavior should be considered negative evidence and when it plays no corrective role. Using the verbal behavior “No!” as an example, the child must discover when “No!” indicates a linguistically anomalous statement or when it is the answer to a well-formulated utterance. This apparently trivial task is in fact a real puzzle for an empiricist learner. Since “No!” can follow both correct and incorrect statements, she can only know whether “No!” plays a corrective role if she somehow already knows if her utterance is linguistically anomalous or not. But this is the information that negative evidence is supposed to provide in the first place (Marcus 1993)!

Chouinard and Clark (2003) contend that Marcus’ argument does not affect reformulation as a type of negative evidence. According to them, an adult’s reformulation that is *semantically equivalent* but phonologically and/or syntactically different from the child’s utterance is understood by her to be a correction. She registers the difference between the two statements and takes this to indicate that something is wrong with her initial utterance. Contrary to Chouinard’s and Clark’s claim, the problem examined above remains. In fact, it exemplifies it! Indeed, not all reformulations that are semantically equivalent but phonologically and/or syntactically different indicate that an error was made. In conversation, we reformulate our interlocutor’s statement (e.g., to clarify it to one’s self) even when it is perfectly grammatical. Hence, the child is still stuck with the task of discovering when a reformulation really means that something is amiss. Reformulation *is* noisy feedback. It could be argued that a reformulation is considered a corrective feedback only when it *contrasts* with the initial statement, to borrow Chouinard's and Clark's expression, in the right way. For example, the right kind of contrast requires that the reformulation while different shares some syntactic and phonological elements with the original. So while (44) is a reformulation of (45), it does not count as a corrective feedback because the differences are too important. (47) is considered negative evidence for (46) because of their overall similarity.

(44) Could you please give my regards to Sue.

(45) Say "hi!" to Sue.

(46) #He eat apple.

(47) He eats apples.

The problem with this suggestion is that it leaves undefined the notion of contrast. What are the properties that statements must share in order to be in this relation of contrast? For example, do (48) and (49) share the right kind of contrast, so that (48) should be seen by the child as negative evidence for (49)? Unlike (46) and (47), (48) and (49) only share one word. Why would the child not interpret (48) and (49) as being too different to be in a contrast relation (i.e., like (44) and (45))? One must also ask the origin of this notion of contrast the child possesses according to Chouinard and Clark. Do children have an innate contrast metric for syntax? Do they learn what contrast is? If so, how do they do this? Without answers to these questions, Chouinard's and Clark's proposal cannot be taken seriously.

(48) #Went outside?

(49) Did you go outside?

There is a final problem undermining Chouinard's and Clark's hypothesis. In order to serve as negative evidence, the child must be able to interpret the reformulation's meaning correctly. This is required if she is to be able to determine that her utterance and the adult's are semantically equivalent, which is the indication that it is syntactic negative evidence. According to the empiricist hypothesis, semantic competence is something that must be learned by the child. *Ex hypothesis*, acquisition will take the form of inductive learning via hypothesis testing. Now, hypothesis testing requires access to negative evidence in order to eliminate incorrect hypotheses. But here reformulation cannot play the role of corrective feedback, because it presupposes the possession of the semantic competence, the acquisition of which is at issue here. On pain of circularity, Chouinard and Clark must explain what will perform the task of negative evidence for the acquisition of semantic competence. Here we go back to the usual suspects, none of which have proved convincing.

While the noisy character of negative evidence necessarily makes the child's task more difficult, some hold that this is not an insurmountable obstacle. Even if no behavior follows only and all anomalous statements, it might be the case that certain behaviors are more likely to follow anomalous statements than well-formed statements. Assuming that the child is capable of detecting this statistical information, which is something she is supposed to be quite good at according to empiricists, she could infer that whenever an utterance is followed by a certain behavior more than X% of times (and only then) the behavior is a corrective signal. Marcus (1993) examines this proposal at length and proves that it cannot work. Based on a rigorous statistical model, he demonstrates that in order to use the difference in the probability of some feedback's occurrence as a reliable source of information to determine whether it is corrective or not, the exact same utterance must be repeated at least 85 times. Unless this threshold is met, the feedback remains ambiguous and essentially useless. In itself, this finding is not sufficient to conclude that noisy feedback is not used as corrective feedback. It is when we compare the threshold requirement with language acquisition and language production data that it becomes clear that noisy feedback cannot be negative evidence. Indeed, studies (Crain, 1991) of acquisition and production tell us that children do not typically produce erroneous statements. Furthermore, they do not repeat the exact same utterances, whether anomalous or not, frequently; like mature speakers they are creative in their use of language. Hence, the odds are extremely low that a given utterance, an incorrect one at that, will be repeated 85 times!

Memory and computational considerations (Marcus, 2003; Crain and Pietroski, 2002) also lead us to be skeptical of this hypothesis. The child is expected to notice that a given utterance generates a certain response (e.g., "No!") more often than other utterances she produces. In order to discover this, the child must constantly keep track of the responses to all her utterances, and keep this information in memory. Then she must process it to discover the relevant statistical trends. This is a massive computational task that requires incredible memory resources and constant attention. While non-demonstrative, these considerations cast serious doubts on the plausibility of the statistical model of negative evidence.

Another problem is how the child is supposed to know the proportion above which a certain behavior should be considered corrective feedback (Marcus, 1993). Is repetition a corrective signal when it follows a given utterance 10%, 5% or 17,453% of the times? This is information that the child must discover on her own. But there is no reliable way for her to do this.

Lastly, notice that the initial puzzle –i.e., knowing when a behavior is used as a corrective feedback seems to imply prior knowledge of whether an utterance is correct or incorrect –is not addressed by the statistical hypothesis. Without a satisfactory solution to this problem, this account does not even get off the ground!

For argument's sake, let's assume that the child is somehow capable of overcoming all the difficulties we have examined. In short, she knows when a certain behavior is negative evidence. Would negative evidence then contribute significantly to language acquisition? It is unlikely. Negative evidence simply indicates that a statement is anomalous. It does not provide substantive information as to why the statement is incorrect. Put differently, it does not indicate which linguistic hypothesis (or hypotheses since the error might be the product of multiple erroneous hypotheses) is responsible for the erroneous utterance. There is an additional problem. Recall that there is a large number of different linguistic hypotheses consistent with the PLE but which are not correct. The rejection of one hypothesis is of little help; the child must still determine which of the numerous consistent hypotheses is the right one; this requires further hypothesis testing. But as we will see below, language acquisition does not follow a trial-and-error pattern.

Again, Chouinard and Clark (2003) disagree with this analysis when it comes to reformulation as negative evidence. The way they see it, reformulation not only indicates that the child has made an error, but also reveals 'the locus of that error' and 'the form needed to correct it'. Consider the child's utterance (50) and the adult's reformulation (51) that Chouinard and Clark give as an example:

(50) #The plant didn't cried.

(51) The plant didn't cry.

Assuming that the child does see (51) as a correction of (50), is it true that (51) tells the child 'the locus of that error' and 'the form to correct it'? There is no reason to believe this. If the child is an empiricist learner, (51) can be interpreted in many ways. Here are a few examples:

(52) (51) is negative evidence for "didn't cried" in this sentential context alone (i.e., "didn't cried" might be correct in other sentential contexts)

(53) (51) is negative evidence for "didn't cried" generally speaking (i.e., but not for "didn't called", "didn't caught", "do not cried", etc.)

(54) (51) is negative evidence for "didn't + past tense of regular verbs" alone (i.e. but not for "do cried", "didn't caught" or "didn't ate")

(55) (51) is negative evidence for "didn't + past participle of regular verbs" alone (i.e., but not for "do sung" or "didn't ate")

(56) (51) is negative evidence for "do + positive/negative + past participles" alone (i.e., but not for "could ate" or "shall not ate")

(57) (51) is negative evidence for "do + positive/negative + past tense/past participles of verbs"

(52) to (57) are only some of the possible interpretations of (51) as negative evidence for (50). There are many others. The plethora of interpretations should be sufficient to prove that Chouinard's and Clark's statement that reformulations identify 'the locus of error' is false. At best, (51) indicates that something is wrong with (50); what exactly is wrong is for the child to discover. Notice that (57), which is the hypothesis that might be said to be the closest to what the child should discover, is both abstract and complex. If the child is really an empiricist learner, we cannot expect that (57) will be the first hypothesis that she will consider. Before she comes to (57), she will test the simpler hypotheses. This scenario does not fit with developmental data and also involves some important demands on memory and cognition.[67]

One could object that some hypotheses will not even be considered by the child because they clash with some hypotheses she already possesses. Hence, the situation is less dire than it seems. This argument is bogus. First, there will be a time when the child will not be able to rely on already acquired linguistic knowledge to exclude possible interpretations of putative negative evidence. Empiricism states that the child starts out with no linguistic knowledge whatsoever and must bootstrap herself into language by means of general learning mechanisms alone. Second, the fact that a new hypothesis clashes with previously accepted linguistic hypotheses does not necessarily mean that the former is wrong. It might well be the opposite! Thus, contradiction with acquired linguistic

[67] It worth pointing out that (57) is not a primitive principle of syntax. It is really a consequence of more primitive and abstract syntactic constraints. Since it is those primitive constraints that the child must acquire, the fact that they are even more abstract increases the problem of the ambiguity of negative evidence.

knowledge is not sufficient to discredit a new hypothesis. In such a situation, the child must retest the whole network of hypotheses in order to make the right call.

Two final points can be made against negative evidence being crucial for language acquisition. The first concerns the universality of negative evidence. In our discussion of comprehensiveness, it was made clear that adult-child linguistic interactions sometimes differ significantly across societies and cultures. In societies where adults do not consider children conversation partners, negative evidence is even more limited than in societies where adults speak and interact with children more frequently. The dearth of negative evidence is even more severe for children who acquire Creole. In such contexts, adults cannot provide corrective feedback because they do not even possess the language acquired by children (Laurence and Margolis, 2001). Pinker (2000) mentions a study carried by Stromswold (1994) in which she assesses a mute boy's knowledge of the past tense formation rules. Since he cannot talk, he did not benefit from negative feedback on his production of past tense verbal forms. Nonetheless, his performance is on par with that of speaking children. The fact that language acquisition does not pose special difficulties for these children proves that negative evidence is not necessary.

The second point concerns 'take up'. The presence of certain types of evidence in the child's environment means nothing if we can conclusively show that she is incapable of using the data. Some linguists have tested whether children are responsive to corrections when acquiring language. In many cases, it appears that children simply do not register the correction (McNeill, 1966; Braine, 1971).[68] It is worth mentioning that in these experiments there was a conscious effort to make the negative evidence as salient and comprehensible as possible. But none of these strategies changed the outcome; children simply ignore the negative evidence and continue using their current linguistic hypotheses. If there is an uptake failure in such a favorable context, we can reasonably assume that uptake would not be better in everyday (i.e., non-experimental) contexts where negative evidence is often less obvious. Furthermore, the fact that uptake does not take place when the negative evidence is in plain sight warrants the hypothesis that the child's own cognitive limits are responsible for the fact that corrective signals are not identified and acted upon.

Cowie (1999) argues that a different kind of negative evidence contributes to language acquisition. It is usually referred to as *indirect negative evidence*. So far, negative evidence referred to different behaviors by members of the speech community that the child is supposed to interpret as indicating she has made a linguistic error. Cowie's claim is that the child also registers a more subtle kind of negative evidence. For example, the absence of certain sentences in the PLE is, she argues, a form of negative evidence. The fact that sentences like:

(58) #What do want you?

(59) #I poured the cup full.

[68] Chouinard and Clark mention studies (Saxton, 1997, Saxton, Kulcsar, Marshall & Rupra, 1998) that demonstrate that children are 'attentive' to corrections in certain contexts. Children recognize corrections and even acknowledge that the adult forms are correct. Nonetheless, they often go on producing utterances that are anomalous. Chouinard and Clark take this to be grist to their mill; it proves that children 'can take in corrective information'. But this is clearly disingenuous. This 'take up' is totally artificial to the extent that children do not assimilate the information found in the corrective signal.

are not in the PLE is interpreted by the child as evidence that these strings are not part of the target language. Hence, this is negative evidence albeit indirect against the grammar that generates these strings.

There is an obvious problem with the notion of indirect negative evidence. The child's PLE consists of only a finite number of sentences, which constitute only a subset of all grammatical sentences that the target language can generate. If the child takes non-occurrence to signify ungrammaticality, then she will end up rejecting many perfectly grammatical sentences.

Cowie is aware of this problem, and for this reason offers a modified explanation of indirect negative evidence. What the child tracks is not the non-occurrence of certain sentence *tokens*, but the non-occurrence of certain sentence *types*. In other words, the child notices that certain syntactic constructions are not present in the PLE, and she infers from this that these constructions must be anomalous. This solves, Cowie contends, the problem raised above. The fact that the child might never have encountered sentence (60) does not count as negative evidence because she has run into sentences with the same structure (i.e., (61)).

(60) The police arrested 5 drug traffickers in the neighborhood bar.

(61) John bought twelve apples at the grocery store.

A closer look at Cowie's suggestion shows, however, that it fails to solve the problems affecting negative evidence. In order for her argument to work, Cowie assumes that the child has access to all grammatical structures allowed by the target language. Not only is this unlikely, it is in fact impossible. For example, Laurence and Margolis (2001) point out that some fully grammatical structures will most likely be absent from the child's PLE for stylistic and/or parsing considerations. This will be the case of so-called 'onion sentences' and 'garden-path' sentences, (i.e.,(62) and (63).) In effect, the recursive nature of language implies that the child will necessarily miss out on some possible grammatical structures. Language not only allows an infinite number of grammatical sentences, but also an infinite number of syntactic structures. Theoretically, one can create infinitely long right-branching and left-branching sentences, each of which exhibits a different syntactic structure (i.e., (64) and (65).)

(62) The rapidity that the motion that the wing that the hummingbird has has has is remarkable. (Pinker, 1994)

(63) Fat people eat accumulates.

(64) Remarkable is the rapidity of the motion of the wing of the hummingbird. (Pinker, 1994)

(65) The hummingbird's wing's motion's rapidity is remarkable. (Pinker, 1994)

Because the child can only be exposed to a finite number of grammatical structures, if she takes non-occurrence as evidence of ungrammaticality, then she would exclude a number of perfectly adequate syntactic structures. But this is not the case. While judgments might be less clear-cut for some kinds of onion sentences and garden-path sentences, long right and left-branching sentences, although rare in the PLE, competent speakers come to recognize that they are grammatical once parsing difficulties –often the result of non-linguistic constraints like memory capacity—are overcome. Thus, non-occurrence is not a determining factor in judgment of grammatical acceptability.

Laurence and Margolis (2001) highlight an additional problem with Cowie's revised notion of indirect negative evidence. They point out that while a given grammatical structure can be instantiated by numerous sentences, the opposite is also true: a given sentence can be interpreted as instantiating many different grammatical structures. What structure a sentence is perceived as exemplifying depends on the grammatical hypotheses one is holding. Consider the case of a child who holds the hypothesis that (66) share the same syntactic structure as (67).

(66) #I want go.

(67) I do go.

This is a completely reasonable hypothesis insofar as both "want" and "do" are verbs that are followed by the same word. While it is true that the child never encounters (66) in her PLE, the fact that she could take (66) to have the same structure as (67) means that she will consider the former to be correct, which is obviously not the case. There are two strategies that Cowie can use to circumvent this problem. She can assume that children will not make these kinds of errors; but this begs the question. Or she can argue that other kinds of corrective feedback (i.e., direct negative evidence) will steer the child back on the right course. But as we saw, little hope should be placed in the traditional notion of negative evidence in the context of language acquisition.

Just like the more traditional notion of negative evidence, indirect negative evidence is computationally implausible (Crain and Pietroski, 2001). In addition to keeping track of those structures found in the PLE, the child is supposed to constantly identify which structures are absent from the PLE. But there are infinitely many structures that do not occur in the PLE (some grammatical, some not), which makes the task impossible both for computational and mnemonic considerations. Furthermore, with each new sentence the child must check whether it corresponds to a given structure found in the database of occurring and non-occurring structures. This too is a Herculean task that would require considerable computational work on the child's part. Given that language acquisition is essentially effortless and extremely fast, the computational requirements involved for using indirect negative evidence are highly suspect.

We started this section by considering three predictions that follow from the empiricist hypothesis. The first prediction stated that if evidence is insufficient, language acquisition will be jeopardized. Ample data have been offered that demonstrate that the PLE the child has access to is significantly impoverished. If the child were an empiricist learner, she would have serious difficulties acquiring language. But this is not the case; children learn to speak easily despite less than optimal evidence. According to the second prediction, differences in the quality of the evidence should cause differences in the linguistic competence acquired. This too proves to be false. We considered a number of examples (e.g., Creole, sign-language acquisition from non-native speakers) where despite exceptionally impoverished PLE speakers acquire a linguistic competence that cannot be distinguished from the one acquired by individuals raised in 'normal' settings. The last prediction is that radically different evidence should contribute to generate substantially different linguistic competences. Here again data do not confirm the prediction. The fact that not one of the three predictions proves to be correct constitutes a powerful reason to reject the empiricist hypothesis.

4.2 The limits of inductive learning

The way inductive learning systems, like connectionist networks, operate can be shown to be incompatible with both the attainment of some essential features of natural language and the characteristic progression of language acquisition. Whereas in the previous section I argue that an empiricist learner cannot acquire full linguistic competence because of insufficient evidence, here the argument is that independently of considerations about linguistic evidence all inductive learning systems, connectionist networks included, are unsuited for language acquisition because of their structural properties. As will become clear, no amount of tinkering with inductive models can solve the problems highlighted here. The shortcomings are direct consequences of the nature of inductive learning.

4.2.1 Trial and error learning

Inductive learning is essentially a ‘trial and error’ process. The learner generates hypotheses, tests them against available data, and decides which should be kept based on the results of the testing procedure. If a hypothesis fits the data, then it is adopted; if it is inconsistent with the data, it is modified based on feedback information. Because she has no prior knowledge about the form of the target language’s grammar, an empiricist learner has no choice but to start with randomly chosen hypotheses and recursively test candidates until she hits the right one. All things being equal, we can expect a significant number of errors during the acquisition process. They should be more frequent and egregious in the initial stages of acquisition and become less prevalent and severe as time goes by. Indeed, the feedback generated by each error is supposed to prod the learner in the right direction when navigating the hypotheses space. Errors are both a natural consequence of inductive learning, and a necessary condition for its success.

Connectionist networks built to 'learn' certain aspects of linguistic competence exhibit all the characteristic traits inherent to inductive learning. Consider Rumelhart's and McClelland's past-tense learning network (1986). At the initial state (i.e., before any training takes place), all the network's connection weights are set at zero, meaning that the network maps input to output in an arbitrary fashion. Thus, given a verb in the present form, the output (i.e., the past form) is randomly generated. This network state is the connectionist implementation of the 'blank slate' assumption. Rumelhart's and McClelland's network displays the progressive learning pattern (with some qualifications that will be discussed below) that is the trademark of inductive learning. The network's performance increases with the amount of training it undergoes until it reaches a plateau after which additional training proves useless. In its learning phase, and even once it is completed, the network produces some incorrect past tense forms, some of which are quite surprising (e.g., mail =>membled; snap=>snappeded; brown => brawned).

The question that must be considered now is whether these characteristic features of inductive learning are observable in human language acquisition. The answer is simple: they are not. Whether it is the number or types of errors produced during the acquisition process, the learning curve, or the end competence achieved, the discrepancies between the inductive model and children are obvious.

Contrary to the empiricist claim, there is ample evidence proving that many principles governing language are not acquired progressively through 'trial and error'. In many cases, children simply abide by the correct linguistic principles from the very beginning and never consider diverging hypotheses. The structure-dependency principle and Binding theory are two examples of complex linguistic principles that are not acquired by the child via trial and error.[69] Despite evidence that is compatible with the structure independent syntax, a child will never consider this linguistic hypothesis. Structure-dependency is a basic assumption that the child takes for granted, and not something that needs to be inductively learned (Crain and Nakayama, 1987). The same holds for Binding theory. There are multiple hypotheses that a child could examine when it comes to the behavior of referring terms (Crain and Pietroski, 2001). Yet, no child goes through the process of recursively testing all or even some of the potential principles that might guide reference. Rather, the child automatically assumes Binding theory with its set of principles governing the relations between anaphora, pronominals and their antecedents. These two examples not only demonstrate that not all linguistic principles are acquired inductively, but they also contradict the empiricist hypothesis that the child has no linguistic knowledge when she begins the process of language acquisition. Clearly, structure-dependence and Binding theory are principles the child brings to the table when

[69] The structure-dependency principle is a constraint such that "operations on sentences such as movement require a knowledge of the structural relationships of the words rather than their linear sequence" (Cook & Newson, 1996)

she engages in language acquisition and they help her reduce substantially the hypothesis space that she needs to survey.

The fact that the child does not acquire inductively all principles governing language is reflected in the relatively low number of errors we find in children's linguistic production (Chomsky, 1986; Crain and Lillo-Martin, 1999). This goes against the empiricist assumption and the behavior of connectionist networks. Not only are errors infrequent but the kind of errors encountered is unlike what we would expect if the child were indeed an inductive learner. An inductive learning system, because of how it operates, will try hypotheses from almost everywhere in the hypothesis space, and consequently will produce all kinds of errors, some being egregious. Rumelhart's and McClelland's past tense generating connectionist network provides a striking example of this. It tests some rather surprising hypotheses that produce really odd outputs like "toureder" for "tour" and " shipt" for "shape". A child never makes such outlandish mistakes. Errors that a child usually generates fall into two broad categories. The first category is overgeneralization. A good example of this is provided by the phenomenon that Rumelhart's and McClelland's connectionist network is supposed to capture, namely past tense formation. Numerous researchers (Pinker, 1999; Berko, 1958; Brown, 1973; see Pinker, 1999 for an exhaustive list) have noticed that children apply the past tense rule for regular verbs (i.e., "verb stem+ed") to almost all new verbs they encounter, sometimes even to verbs they previously treated as irregular (e.g., eated) and to past tense forms of verbs (e.g., ated). Unlike the connectionist network of Rumelhart and McClelland, the child's errors essentially limit themselves to this type alone. Errors are not random like what the connectionist network produces, but result of the overgeneralization of the correct rule. One can argue that the overgeneralizing child is not really wrong when applying "verb stem+ed" to all verb stems. Indeed, irregular verbs are fossilized products of rules that have disappeared from the language as a result of historical contingencies (Pinker, 1999). Nothing would be lost syntactically or semantically if they would be transformed into regular verbs. When the child overgeneralizes, she shows that she has correctly internalized a central component of the target language (in this case a piece of inflectional morphology) but has yet to master some of her language's quirky but ultimately peripheral features.

The second kind of error that is sometimes witnessed involves the adoption of a linguistic principle that is not part of the target language, but which is nonetheless found in some natural languages. For example, Thornton (1990) points out that 1/3 of English speaking children go through a stage where they add an extra Wh-word when they generate long-distance questions, as in (68) and (69) (examples from Crain and Thornton, 1998; Thornton, 1996):

(68) What do you think what pigs eat?

(69) Who did he say who is in the box?

These sentences are not acceptable in English; native speakers of English never produce sentences with medial-Wh once they have acquired full command of the language. What is interesting, however, is that many languages permit question sentences with medial-Wh. German is one. (70) is a perfectly acceptable in German:

(70) Wer mochtest du wer zum deinem Geburstag kommt?

It is argued by many (Pinker, 1984; Crain, 2001) that most errors made by children that are not overgeneralizations or consequences of performance issues can be analyzed in the same way: children might be using an improper rule with respect to the target language, but they always abide to rules found in other natural languages. For instance, the child does not contemplate the question formation rule that licenses the inclusion of medial lexical Wh-phrases (Crain and Pietroski, 2001):

(71) Wessen Buch glaubst du wessen Buch Hans liest?

(72) Whose book do you think whose book Hans is reading?

Such a rule is absent from any known language, and most likely incompatible with the very structure of human natural language. This feature of language acquisition is at odds with the properties of inductive learning. A true inductive learner would not exhibit this strong bias for rules found in human natural languages. There is no reason why she would test only the medial Wh-word hypothesis and not the medial lexical Wh-phrase hypothesis.

The 'trial and error' nature of inductive learning makes it difficult to account for other well-known facts about language acquisition: its strict developmental course, its universal success, and its speed. Language acquisition proceeds according to a fairly rigid timeline for all children. They reach the same language milestones (e.g., babbling, first words, first sentences) in the same order (Guasti, 2002; Petitto, 1995). They make similar linguistic hypotheses at about the same time. For example, children speaking different languages tend to overregularize irregular verbs or drop sentential subjects during language acquisition (Guasti, 2002). If acquisition functioned according to 'trial and error' approach, it would be highly unlikely that such regularities would arise both because of the important environmental differences in which acquisition takes place, but also due to the nature of the inductive process. Differences in PLE would lead children to entertain different linguistic hypotheses at different times. In fact, even if we assume, *ex hypothesis*, that two inductive learners have access to the same PLE, it is very likely that they would produce different hypotheses because of the PLE's ambiguous nature.

A child raised in an English community will acquire English and will have complete knowledge of all aspects of the language. We never encounter cases where a child who had access to English ends up speaking a language that is not English or only approximately English. But if acquisition is a 'trial and error' procedure, we would expect at least some children to converge on languages that are slightly off target. Considering the complexity of human natural languages, the paucity of positive evidence and the dearth of negative evidence, this should be relatively frequent. In many cases, it would be quite difficult to detect these divergences because the erroneous principles do not have readily assessable consequences, at least for the layperson. A case of the subset problem examined by Crain and Lillo-Martin (1999) makes this clear. Consider sentence (73):

(73) Brian is pulling a heavy box and Jeff is pulling one, too.

An inductive learner might be tempted to interpret (73) as meaning (74):

(74) Brian is pulling a heavy box and Jeff is pulling a box (heavy or not) too.

(74) is not how (73) is interpreted by mature speakers of English. Indeed, the interpretation of (73) is rather (75):

(75) Brian is pulling a heavy box and Jeff is pulling a *heavy* box, too.

Because instances of pulling a heavy box are always instances of pulling a box *simpliciter*, all situations that confirm (75) also confirm (74). Hence, an inductive learner would have some good reasons to try out (74) and even adopt it. Odds are low that opting for this linguistic hypothesis would cause negative consequences. Obviously, it is possible to create experimental contexts by which we can determine which of the two interpretations a speaker adheres to. For example, if a speaker assents to (76) when Brian is pulling a heavy box and Jeff a light one, we know that they interpret (73) as meaning (75).

(76) Brian is pulling a heavy box, but Jeff isn't pulling one.

If the speaker dissents to (76), then she understands (73) as meaning (74). If language acquisition is an inductive procedure, we would expect that some individuals raised in English speaking communities would interpret (73) as meaning (74). Yet, it is never the case. Every child who acquires English knows that (75) is the correct interpretation. There could not be such unanimity in interpretation if we acquired language by 'trial and error'.

Language acquisition happens at a very brisk pace. By age 4, a child has a full mastery of the phonology, morphology, syntax and, to a large extent, semantics of her native language. An inductive learning mechanism that proceeds by 'trial and error' cannot sustain such a rapid acquisition process. Given the number of principles compatible with the PLE, the 'trial and error' approach is inefficient. Rumelhart's and McClelland's connectionist network for the formation of past tense of verbs provides a very good example of this. Rumelhart and McClelland trained their network by exposing it 10 times to a set of 10 high-frequency verbs (e.g., come/came, get/got) and 190 times to a set of 420 pairs of medium-frequency verbs. In total, the network processed 79900 verb pairs during its training. At the end of the training phase, the network still makes some errors when generating the past tense form of verbs found in the training set. Rumelhart and McClelland also test their network on a series of 72 verbs that were not part of the training set. Here the results are abysmal (Pinker and Prince, 1988). For 24 verbs, the network provides an incorrect output, meaning that the network's success rate after being trained almost 80000 times is not even 70%! Furthermore, the errors made by the network are nothing like those children make. For example, the network failed to generate any output for verbs like "warm", "trail" and "glare". This never happens with children. English speakers, if they do not know the past tense form of a verb, will either apply the default rule "verb stem+ed" or produce a plausible irregular form. When the network actually provides an output, albeit incorrect, errors range from the seriously bizarre (squat-squakt, mail-membled, snap-snappeded) to oddly wrong (sip-sept). We find no analogue of such egregious errors in children speech production.

The performance of connectionist networks in speed of acquisition appears even worse when we consider that a child is often capable of acquiring complex linguistic knowledge after a *single* exposure to positive evidence. One domain where this phenomenon has been widely studied is word acquisition. There is substantial evidence showing that a child can acquire the meaning of a word based on a single encounter. This capacity is called *fast-mapping* (Bloom, 2000). Inductive learning is the antithesis of fast-mapping. Indeed, inductive learning is the progressive accumulation of knowledge by testing and correcting hypotheses.

Fast-mapping is automatic acquisition without recursive testing. It proves impossible to model fast-mapping using connectionist networks that have no preset biases for generating the correct output

4.2.2 Systematicity

As noted, despite extensive training, Rumelhart's and McClelland's connectionist network for past tense formation is not very successful when dealing with verbs it has not been trained on. Rather than opting for the default hypothesis "verb stem+ed" when it encounters a verb for the first time, the connectionist network comes up with outputs that are both incorrect and bizarre. This behavior of Rumelhart's and McClelland's connectionist network is very different from what we witness when we analyze children's outputs. Unless they have grounds to think otherwise, children systematically apply the "verb stem+ed" principle when asked to form the past tense of a new verb. There is no real difference from the child's perspective between a verb she has seen a 1000 times and one that she just encountered for the first time; she knows that "verb stem+ed" is the way to generate past tense forms for all regular verbs whether old or new.

The fact that the child knows that "past tense = verb stem+ed" holds for all possible regular verbs is an example of what philosophers call the *systematicity* of linguistic competence. Systematicity refers to the fact that knowledge of certain properties is 'intrinsically connected' (Fodor and Pylyshyn, 1988) with the knowledge of other properties. Someone who knows English and who knows that a given string is a regular verb automatically knows that the past tense of this verb can be generated by adding “-ed” to the verb stem. There is ample evidence that by and large linguistic competence is systematic. For example, to know that an expression can play the role of subject in a sentence entails that one also knows that the same string can be the object in a sentence. If one can understand the sentence “Juliet loves Romeo”, then one necessarily understands the sentence “Romeo loves Juliet”. There are hundreds of other examples like these that show the systematicity of many aspects of linguistic competence.

A simple explanation for the systematicity of linguistic competence is that language consists of rules (i.e., functions over variables), and that knowledge of language amounts to knowledge of these rules. For examples, English speakers will systematically add “-ed” to all regular verb stems when they need their past form because knowledge of English amounts, among other things, to the possession of the rule “For all X, if X is a regular verb, then the past tense of X = X+ed”. While this is both an elegant and cogent explanation of the systematic nature of linguistic competence, it is one that empiricists can neither assume nor account for. As we saw in the previous section, the impoverished and ambiguous nature of the PLE makes it highly unlikely that a child who relies on induction alone could discover the complex rules governing language. But there is another problem. The most sophisticated inductive learning mechanism, and also the only one whose details are sketched out with some degrees of precision, empiricists have at their disposal, namely the connectionist network, *cannot acquire* functions over variables (Marcus, 1998, 2003)! Insofar as systematicity requires functions over variables, connectionist networks cannot exhibit true systematicity.

The argument proving that a connectionist network cannot acquire functions over variables is relatively straightforward. There are various versions of it (Fodor and Pylyshyn, 1988; Pinker and Prince, 1988); I will focus on Marcus' concise version (1998, 2003). Before we consider it, one potential cause of confusion must be dealt with. The claim being made is not that it is impossible to build a connectionist network that makes use of variables and that performs operations over variables. This is obviously false. It has been proven that one can implement any function using a connectionist network if one has complete freedom when it comes to the network's architecture (Marcus, 1998). What Marcus' work proves is the weaker thesis that the kind of connectionist networks (i.e., feed-forward networks and simple recurrent networks) that empiricists propose cannot learn functions over variables.

Connectionist networks' incapacity to acquire functions over variables can be explained in terms of what Marcus calls the 'training independence of nodes'. When presented with an input, a number, say x (where $x \geq 1$), of the network's input nodes are activated.[70] In turn, those nodes activate nodes connected to them, until the output nodes are finally triggered. Notice that for any given input, the only nodes and weights it affects are those nodes and weights to which the input nodes are connected. Nodes and weights that are unconnected to the activated input nodes are not trained by the input.[71] The same situation holds in the other direction. When the network is corrected by means of back-

[70] There are different ways that the input can be represented in a connectionist network. Certain networks adopt a paradigm of distributed representation, meaning that a given input or output is represented by the activation of a combination of input or output nodes. Other networks assign a node to each possible input and output value.
[71] Of course, input nodes that are not activated do not affect any nodes or weights.

propagation, the only nodes and weights corrected are the nodes and weights that are ultimately connected to the output nodes that were activated. Thus, connectionist networks require that each input and output node be individually trained, and it is in that sense that nodes exhibit training independence.

Consider now one type of function over variables, namely what Marcus (2003) calls 'universally quantified one-to-one mappings' (henceforth UQOTOM). The distinguishing feature of such functions is that each input value maps onto its own unique output value. The "past tense = verb stem +ed" is a universally quantified one-to-one mapping; each regular verb stem (i.e., input value) maps onto a past tense form (i.e., output value) that is unique to it (e.g., love=loved; bake=baked, etc.) Language is full of UQOTOM functions (e.g., plural formation), which make them relevant for our purpose. The question is whether a connectionist network can acquire a UQOTOM function. Obviously, a connectionist network has no problem with one-to-one mapping functions when its training set contains all possible input-output pairs. Given sufficient training runs using such a set, the network's performance will be close to perfect. But this is nothing more than rote learning, which is an uninteresting case.

The interesting scenario is when a network is trained for a UQOTOM function using a set of input/output pairs that does not include all possible input/output pairs for the function. So, for instance, we train the network for the English plural formation rule (i.e., For all X, if X is a regular noun, then the plural of X is X-s/-es) by providing a set containing a finite number of singular/plural noun pairs. What happens when a network trained with such a set is confronted to an input value that is not only absent from the training set but also outside the training space constituted by the training set?[72] In simpler terms, what happens when the input value activates a node or a combination of nodes that was never activated during the training phase? Marcus (1998) notes that there will always be at least one such input value whenever the set of input values is unbounded, whatever type of input representation the network uses. This is precisely the case for plural nouns. The set of potential nouns that can be pluralized is unbounded; we can always generate new nouns ("wug", "bibjo"). For a plural forming network, a nonsense noun like "bibjo" would be an instance of an input that is outside the training space.[73] Given such a novel input, can the network generate the right output? Keep in mind that the output will also be novel. In a UQOTOM function, each input value has its own unique output value.

In such conditions, a connectionist network will fail to behave correctly because of training independence. Training independence entails that the training sessions to which the network was submitted will have left the connections between a novel input and its equally novel output unoptimized. It cannot be otherwise because both the combination of nodes for the input value and the combination of nodes for the output value have never been activated before. As such, the connection between novel input and novel output is no better than random, leading to odd outputs like those examined earlier in our discussion of Rumelhart's and McClelland's network. No amount of training or tweaking of the network's architecture will change this fact.

[72] The notion of *training space* (Marcus, 1998) refers to the set of input values that can be generated based on the features of input values found in the training set.
[73] Of course, the network must somehow know that the new input is a noun and not a verb, adverb or adjective. This is an additional problem that the connectionist model must solve.

But if this is the case, then it is clear that the network has not acquired the target function. Successful acquisition entails that there is a systematic mapping of each input value to its correct output value for the function's whole domain of application (i.e., all possible input and output values). The conclusion, then, is that functions over variables are beyond the acquisition capacities of connectionist networks because of their very structure. To the extent that functions over variables are both pervasive in language and essential to account for the systematicity of linguistic competence, this is a serious objection to the claim that the connectionist paradigm offers a genuine explanation of language acquisition.

4.2.3 Creativity

A characteristic feature of language use is its creativity. I have already discussed some aspects of linguistic creativity in the section on the poverty of linguistic evidence. I want to return to the topic in a more systematic fashion and see whether induction and the connectionist paradigm are compatible with linguistic creativity.

Linguistic creativity refers to the fact that any speaker can generate an unbounded number of grammatical sentences expressing novel thoughts in a way that is both appropriate to the discourse context in which they are uttered and yet uncaused by external factors. We can unpack this statement as follows. Language use is an essentially *productive* process. When we speak, we constantly create words and sentences that have never been uttered before. Productivity holds for all components of language; we are productive when it comes to phonology, morphology, syntax, and semantics. A few examples will make this obvious. For instance, it is always possible to take a noun and transform it into a verb (and vice versa). I can turn the noun "ear plug" into the verb "to ear plug", which means [to insert ear plug] as in (77):

(77) I ear-plugged Johnny so he would not hear my conversation.

This kind of transformation is not limited to common nouns; it can also used with proper nouns. Take the proper noun "Reagan". It can be used as a verb as in (78) and (79):

(78) Bush reagans his way out of problems.

(79) George W. Bush out-Reaganed Reagan.

(78) means that Bush uses Reagan's tactics to get himself out of trouble. (79) signifies that Bush has taken Reagan's style and politics to a level that is beyond that of Reagan himself. Notice that (79) offers also an example of morphological productivity; the affix "out-" is added to "Reagan" in order to create a new lexical item. Sentences (77)-(79) are also examples of semantic productivity. These statements show how words can be used to express meanings that are unconventional if not entirely new. With respect to syntax, productivity is omnipresent in all the new sentences we generate. You have probably never read or heard anywhere else most of the sentences found in this dissertation. The syntax of natural language is such that it allows for infinitely many well-formed sentences, and we make use of this property everyday when we talk and write.

Productivity would be of little use if the novel statements we generate would fail to convey our thoughts effectively, be irrelevant to the context of utterance or be constantly interpreted incorrectly by our interlocutors. But we do not encounter these problems. As a rule, our linguistic production is *appropriate*.

It accurately reflects our thoughts; it is pertinent; and it is properly grasped by our audience. Taking into account the incredible range of topics we address on any given day –from the most banal subjects to the most intricate and subtle ones— and the basically unlimited options provided by language, it is surprising that language production is indeed overwhelmingly appropriate.

While not the only one to have made this point, Descartes (see Chomsky (2002) for additional references) is the best-known philosopher to stress the fact that human language use is intimately related to freedom. What humans say, unlike what can be observed in animal communication, is not determined by factors external to the speakers.[74] While context and events may lead us to say certain things, they never constrain our linguistic production. The debacle of behaviorism illustrates the fact that there are no strict relationships between environmental factors and what we say. What we do say is the result of our free decision, which cannot be predicated from extraneous causes or –for that matter— internal states. Notice, by the way, that the free nature of language use makes the issue of appropriateness of use even more perplexing. If our utterances were triggered by environmental factors, then this would explain, if only partially, why what we say is relevant to the context. The 'stimulus freedom of language', to borrow Chomsky's terminology, is a puzzling fact that is still largely unexplained.[75] Some have been tempted to reject the readily observable facts as remnants of a pre-scientific understanding of human nature in general and language in particular. Given the robustness of the stimulus freedom

[74] The topic of animal communication is discussed at length in the second part of this dissertation.
[75] Some, like Chomsky, believe that we will never be able to fully understand the creative use of language because of the inherent limits of our cognitive capacities.

observations, such a strategy is unwise. Any scientific theory of language should try its best to explain or at least accommodate the free nature of language use.

Could a child acquire the necessary competence for linguistic creativity by means of an inductive learning mechanism like a connectionist network? All the evidence available leads to a negative answer. Let's begin by considering syntactic productivity. A hackneyed example is that it is always possible to add a relative clause to a noun phrase in a sentence, yielding each time a new and perfectly grammatical sentence. Based on the noun phrase "the man" used in sentence (80), we can generate (81), (82), (83), and we can go on indefinitely.

(80) The man is behind the door.

(81) The man who carries a big knife is behind the door.

(82) The man who carries a big knife and has evil intentions is behind the door.

(83) The man who carries a big knife, has evil intentions, and wants to kill me is behind the door.

How the child acquires the necessary syntactic competence required for productivity is difficult to explain if she can only rely on an inductive learning mechanism. Indeed, underlying this example of productivity is a principle of universal generalization, not unlike the UQOTOM function examined in our discussion of systematicity. The child is expected to learn that for any noun phrase she can always attach an additional relative clause if she respects some minimal constraints. In other words, the child must internalize a universal function (one which applies to all possible noun phrases) with variables (i.e., noun phrase, relative clause, output noun phrase). But we just saw in the discussion on systematicity that connectionist networks cannot successfully acquire functions of this type, which precludes them from exhibiting genuine syntactic productivity. The pseudo-generalizations that they successfully 'learn' do not support the syntactic productivity that speakers display because connectionist networks are incapable of going beyond the boundaries of the training space delimited the training set's data. To use Marcus' terminology, connectionist networks cannot successfully *extrapolate*. Yet, this is precisely what syntactic productivity would require networks to do!

Architectural constraints also make connectionist networks incompatible with syntactic productivity (Fodor and Pylyshyn, 1988, Pinker and Prince, 1988). In order to grasp this problem, we must return to an important property of connectionist networks. Until now, we have been focusing on connectionist networks as acquisition devices. The network is the means by which information is extracted from the environment and internalized by the system. But there is another facet to connectionist networks. Because learning in the connectionist paradigm is the tweaking of connection weights and activation thresholds across the network, the acquired competence is indistinguishable from the network itself. Put differently, the competence is *distributed* over the network. The problem, however, is that if the internalized linguistic competence takes the shape of a specific connectionist network configuration, then syntactic productivity is impossible. Indeed, we know that, by definition, a network has a finite number of input, output and hidden layer nodes. The number of input and output nodes limits what inputs and outputs the network can process and generate. For example, a network that has ten input units and ten output units cannot represent an input which requires 11 input units and 11 output units[76]. This is simply a consequence of its architecture. We know, however, that syntactic productivity signifies, among other things, that there is no upper limit to the length of sentences that a speaker can generate (i.e., we can always insert an additional "very" in the sentence "This sentence is very long"). For any connectionist network with a fixed number of output nodes, whatever the representational scheme it implements, there will always be syntactically correct sentences that are beyond its output capacities. In short, connectionist networks do not allow for unbounded outputs because of their architecture. Insofar as language production is unbounded, this failing is serious.[77]

Could one devise a connectionist network that could adapt itself to input and output requirements by subtracting or adding input and output nodes as required? This is not an option, as Fodor and Pylyshyn (1988) make clear. By adding or subtracting nodes, we modify the network's structure. But as was just mentioned, what the network has acquired is captured by its configuration. To change the configuration is to change the network's computational capacity. A network trained for a certain task will see its performance affected if its structure is tampered with. To achieve peak performance again, it would need to be retrained.

[76] Imagine a network with binary input and output nodes (i.e., nodes have two states, 0 or 1). If the network has 10 input nodes and 10 output nodes, it can represent at input and output 10 digit long binary numbers (e.g., 0000000001). Anything longer (e.g.00000000011) is beyond the representative capacity of the network.

[77] I have been focusing on production, but a similar problem arises with interpretation. Because of the unbounded nature of language, there is no upper limit on the length of input we might have to interpret. A network with a finite number of input nodes cannot cope with this eventuality. Notice that this limit also has some consequences for acquisition insofar as acquisition requires the parsing of the strings whose length is not bounded.

Another strategy adopted by some connectionists is to point out that speakers' capacity to successfully parse sentences is also constrained by factors such as syntactic complexity and length. While linguistic competence might entail *in theory* that there is no limit to the length of sentences a speaker can compute, *in practice* we know that there are such limits. Attempts to parse very long sentences or sentences with especially complex syntactic structures (e.g., onion sentences, garden-path sentences) often fail. It is possible to draw a parallel between these parsing difficulties and the computational limits inherent to connectionist networks. It is precisely because linguistic acquisition and competence are instantiated by connectionist networks that our parsing capacities are constrained the way they are.

The problem with the connectionist explanation is that there is a simpler and more elegant one available. The parsing problems are not caused by limits inherent to the language computational system, but by limits of other cognitive systems like memory. For example, constraints on short-term memory determine the maximum amount of information that can be kept 'online' for processing at a given moment. When the limit is exceeded, there is a memory overrun and the computational processes crash. This is probably what happens when we are confronted by some onion-sentences and garden-path sentences. Long garden-path sentences go over short-term memory capacity and parsing halts. Subjectively, this is experienced as a failure to formulate or interpret the sentences in real-time. If our short-term memory had a bigger capacity, we would probably have less difficulties dealing with such sentences. Also, when we analyze these sentences in contexts where we do not have to rely exclusively on short-term memory, we can often parse them successfully. This offers additional support to the hypothesis that such sentences are not incompatible with the language computational system itself.

Semantic creativity also proves to be a problem for proponents of induction and connectionism, although few actually take this issue seriously. When pressed about the question of semantic creativity, the initial response is to point towards the innate analogical capacity that we are supposed to possess. It is claimed that instances of creativity can be accounted for in terms of analogical extensions of the expression's meaning. Because empiricists argue that the analogical capacity is innate, it is not something we learn, but something we bring to the table when we acquire language.

Unless one is able to provide a robust theory explaining what analogy is precisely, arguing that creativity is made possible by analogical thinking is not very helpful. Philosophers do this quite frequently (e.g., Putnam, 1979b, Quine, 1960). Unlike most philosophers, some psychologists and cognitive scientists (e.g., Gentner *et al.*, 2001; Fauconnier, 2001) have tried to provide a formal account of analogy. Looking at their work, perhaps we will be able to see whether analogy holds the key to semantic creativity.

The state-of-the-art view is that analogy is a kind of 'structure-mapping' or 'structural alignment' (Keane and Costello, 2001).[78] The name 'structure-mapping' highlights an essential aspect of analogy: it is a two-place function. Analogy links concepts that are from different semantic domains. Without going

---

[78] It has been brought to my attention that the current state-of-the-art in psychology is strikingly similar to what Goodman defends in *Languages of Art* in the mid-seventies.

into all the details, structure-mapping can be summarized as a threefold process. The first step consists in the analysis of the conceptual structure and properties of each concept that will enter in the analogy relation. In the second, both structures and properties are compared in order to detect relevant commonalities. Commonalities can be of various kinds: shared structure, shared components, etc. If such commonalities exist, then it is possible to draw an analogy between both concepts. To illustrate the process, consider the following example.

(84) Donald Rumsfeld is a weasel.

The analogy holds because both Donald Rumsfeld and weasels are deceiving and conniving. Both entities also share other properties (e.g., being living things, animals, etc.), but the analogy focuses on their common treacherous behavior.

How does analogy defined as structure-mapping allow for semantic creativity? The conclusion one reaches after a survey of recent literature on the question (Gentner, Holyoak and Kokinov (eds.), 2001) is that analogical reasoning supports creativity in two ways. First, it makes it possible to draw unexpected connections between concepts, like in (84), which yield semantically novel statements. Creativity is the result of the associative possibilities of analogical reasoning. Simple associative analogy can only go so far in accounting for semantic creativity. Even a casual look at normal language production is sufficient to see that most instances of creativity do not take the form of straightforward analogies like (84). They are usually much more complex and subtle. Subtler cases of semantic creativity are in the domain of what Fauconnier (2001) calls *conceptual blending*, which is a more complex form of analogical reasoning. Conceptual blending relies on the analogical structure-mapping procedure but is different from simple associative analogy insofar as it generates a third concept that is distinct from those that entered the blending procedure. The resulting concept, what Fauconnier calls the *blend*, is essentially original. Put differently, the blend is the product of the analogical aligning of input concepts but it 'is not a simple composition' of these. Quoting Fauconnier, "[T]hrough pattern completion and dynamic elaboration, it (i.e., the blend) develops an emergent organization of its own" (2001, 256). An example of conceptual blending is the statement 'to dig one's own grave' (Fauconnier, 2001). According to Fauconnier, the expression is a complex mapping between the 'death and graves conceptual frame' and an 'action and failure conceptual frame'. These conceptual frames are merged generating a statement whose meaning is 'more than the sum' of the meaning of its parts. In the case of blending, analogy does not simply play an associative role (e.g., X is like Y) but it is a truly creative process.

At first glance, we have what appears to be a detailed hypothesis about the role of analogy in semantic creativity. The question, then, is whether this account is convincing. I contend that it is not.

The first problem undermining this account is its extreme vagueness. If one goes beyond the often empty jargon used, there is very little substance to the 'theory' of analogy, at least when it comes to the question of semantic creativity. This is most obvious when we examine the 'conceptual blending' story put forward by Fauconnier. Notions like 'emergent properties', 'pattern of elaboration', 'transfer' and 'dynamic completion' are never fully worked out. The principles governing these processes and their objects remain undetermined[79], which makes it difficult to assess the soundness of Fauconnier's position. Consider, for example, what he has to say about processes responsible for the meaning of the expression 'to dig one's own grave'. It is the result of a 'double-scope blend' that organizes one input, the 'frame of death and graves', with another input, the 'causal and temporal structure'. How this double-scope blend operates remains fuzzy (Fauconnier and Turner, 2003). Fauconnier argues that the double scope blending operation incorporates only some of the properties of each input into the blend. Nothing is said, however, about the process by which certain properties from the inputs and not others are selected to make the final cut into the blend. In the 'to dig one's own grave' case the 'intentional structure' of the blend comes from the 'action and failure conceptual frame' and not from the 'death and grave digging frame'. But why not the opposite? The success of blending seems to rely on some *deus ex machina,* which is extremely unsatisfying. This impression is not unlike the one created by philosophers' use of analogy to explain creativity. Whenever confronted with the problem of semantic creativity, they simply conjure up an 'analogical power'.

Cognitive observations also undermine the model of creativity based on analogy. Semantic creativity is fast and effortless. We do it all the time without having to actively think about it. The capacity for creativity seems to be pretty much independent of intellectual capacities and non-linguistic knowledge. Individuals with serious intellectual impairments (e.g., Williams syndrome individual) are just as capable of creativity as the average speaker. In contrast,

[79] From what I can gather, everything from thoughts to actions can be conceptually blended.

cognitive research shows that analogical reasoning, and a fortiori conceptual blending which is an even more complex mental operation, is a relatively slow cognitive process (Keane and Costello, 2001; Goldstone and Medin, 1994). It takes more time for someone to analyze and understand an analogy like ‘my job is like a jail’ than instances of creative use of language. Parsing analogies requires more time because it involves some amount of conscious rational deliberation. Another interesting point is the fact that analogy production and comprehension often rely on real world knowledge to be successful, not merely on semantic knowledge. We see, in effect, that creativity and analogy are cognitively quite distinct, and as such the latter cannot be the primary mechanism of the former.

The final objection to the analogy theory offered by Fauconnier is that many instances of semantic creativity do not require the use of conceptual blending. To be more specific, conceptual blending with its complex and poorly defined structural mapping/alignment is simply overkill. Take sentence (85):

(85) Chomsky’s book on 9/11 is at the origin of a huge controversy.

Fauconnier’s explanation for the meaning of this sentence would most probably involve multiple scope blending operations where the ‘book conceptual frame’ is blended via structure mapping and alignment with ‘the origin conceptual frame’ and the ‘controversy conceptual frame’ in some way or another. A much simpler explanation is that words allow for creativity because their meaning offers us many ‘open-ended perspectives’. As we saw earlier, “book” means both something concrete (i.e., the physical object) and abstract (i.e., what is expressed by the words found in the book). The same concrete/abstract distinction is arguably also present in the word “origin” and “huge”. As such, the book (qua expression of ideas) is the origin (qua abstract starting point) of a huge (qua abstract property) controversy. There is no need for analogy or blending; it is all accountable in terms of the inherent conceptual resources of each word. We see, thus, that empiricist talk of innate analogical faculty does not amount to an explanation of semantic creativity. Connectionism is also antithetical to semantic creativity for reasons similar to those considered in the discussion of syntactic productivity. Because a connectionist network does nothing more than repeat the stochastic trends inherent to the data it was trained on, it cannot be genuinely creative.

Our focus so far has been the productivity aspect of creativity. Let’s turn to the other facets of creativity, namely appropriateness and stimulus freedom. Here too inductive learning mechanisms fall short. Despite extensive training, we saw that connectionist networks never overcome their propensity to make egregious errors of all kinds. From weird past tense forms to improper answers in sentence completion tasks, connectionist networks are prone to produce inappropriate outputs. Unlike normal human beings, connectionist networks remain unable to internalize the principles required for truly appropriate speech production. Could additional training solve this issue? This is extremely improbable within a realistic timeframe. The more likely conclusion is that inductive mechanisms like connectionist networks are just not the kind of cognitive mechanisms that can exhibit appropriateness.

Stimulus freedom means that language production is not simply an automatic reaction to external causes acting on the speaker. There is no strict correlation between subject independent factors and what the speaker says. Thus, linguistic competence cannot be reduced to a long list of principles like ‘Given subject-external factors X,Y,Z, utter statement S’ or disposition statements like ‘Given subject-external factors X,Y,Z, the subject is disposed to produce statement S’ because there are no necessary or even sufficient subject independent factors for the production of utterances (Chomsky, 1967). Notice, however, that inductive learning mechanisms reduce linguistic competence to a set of such conditional principles. Indeed, language acquisition is for empiricists nothing more than the discovery, the formalization and the internalization of relationships between observable properties and linguistic utterances. Connectionist systems do the same thing but the ‘knowledge’ is distributed over the network. This is only a superficial difference. Because induction cannot yield linguistic principles that are not strictly indexed on environmental factors, it is incompatible with the stimulus freedom requirement. Principles compatible with stimulus freedom must have strictly subject-internal use conditions, which make them independent from subject-external factors.

4.2.4 Connectionism and the brain

Proponents of connectionism stress the similarity between connectionist networks and the neural structure of the human brain. In fact, they often argue that connectionist networks are a *structural analogue* of the cerebral neural network. They consider this similarity to be a crucial point in favor of their model. Indeed, they think it will enable them to quickly solve the thorny question of the biological realization of cognitive processes. As a rule, cognitive theories are higher-level descriptions of cognitive processes and are not directly concerned with issues of physical implementation. For example, linguists will define syntactic competence in terms of knowledge of certain rules, but they will not try to describe how these rules are realized in the brain. They leave this task to neuro-physiologists and the like.

The task of interfacing cognitive theories with biology is far from trivial. The components of our cognitive theories rarely have obvious correlates at the physical level, and a plethora of philosophical considerations make it difficult to equate cognitive states/events with physical states/events. But if connectionists are right, there is a clear connection between the cognitive and the biological explanations via the concept of neural network. Cognition is reducible to the behavior of neural networks and the brain is nothing more than a network of neural networks. For some, this position solves (or dissolves) most if not all difficulties that fall under the heading of the 'mind-body problem' (Churchland, 1995) and delivers us from many philosophical 'puzzles'.

The assumption upon which the connectionist position rests is that connectionist networks and the brain are structural analogues. This assumption is debatable. There are many important structural differences between the brain and a connectionist network that undermine the structural analogy claim. The most important difference concerns backpropagation. As we saw earlier, backpropagation is a core component of the learning mechanism of recent connectionist models. Backpropagation allows the network to modify, during the training phase, the connection weights and the nodes' activation threshold based on the comparison of the network's output with the target values found in the training set. The difference between the network's output and the correct output is computed, and the network is reconfigured starting from the output nodes back to the input nodes. In other words, error correction propagates backward from the output layer to the input layer. The problem is that there is no known cerebral process analogous to backpropagation. Information does not flow backward to neurons to reconfigure them.

A quick survey of the connectionist networks built for language acquisition shows that most use backpropabation as their learning algorithm (Elman *et al.*, 1996). But since backpropagation is biologically impossible, these networks are not structural analogues of actual neural networks found in the brain. While connectionist networks and the brain do share some analogous components (e.g., nodes/neurons, etc.), the important difference in the learning mechanism they use means that they should be carefully distinguished.

The fact that connectionist networks and the brain are different with respect to vital features undermines one of the main points in favor of connectionism. Connectionism cannot save us from the problem of physical realization of abstract cognitive processes. What about, then, considering connectionism as a higher-level description of cognitive processes that idealizes away from biological considerations. In other words, connectionism would be similar to most cognitive theories that focus strictly on explaining the cognitive level and leave questions of physical realization aside. Construed this way, connectionism is nothing more than species of associationism, the venerable but flawed account of learning that has attracted empiricists for centuries. Yet, what legitimizes an idealization is whether or not it yields a robust theory that explains the phenomena. When it comes to language acquisition, there is ample evidence that connectionism is not a very successful theory. Thus, it deserved to be discarded.

4.2.5 Domain-general learning mechanism hypothesis

A core tenet of empiricism is that language acquisition is not made possible by language specific cognitive capacities, but by domain-general inductive mechanisms that are sometimes called as a group ‘general intelligence’ (Putnam, 1979b). ‘General intelligence’ is also responsible for all instances of learning irrespective of the domain. This hypothesis entails a number of testable predictions, two of which I want to consider. First, a compromised ‘general intelligence’ should interfere with the normal and complete acquisition of language. Second, given normal ‘general intelligence’ and sufficient linguistic evidence, someone should be able to acquire language. As we will see, both predictions prove incorrect.

Anecdotal evidence that individuals with intellectual deficiencies and impaired learning capacities are able to acquire and use language are not new. For instance, Descartes (quoted in Chomsky, 2002, 51) observes that

> It is quite remarkable that there are no men so dull-witted or stupid –and this includes even madmen—that they are incapable of arranging various words together and forming an utterance from them in order to make their thoughts understood (…).

Descartes’ observation has been confirmed over the years by numerous studies of language acquisition and use by atypical children. One source of confirmation comes from the study of children who suffer from a rare genetic disease called Williams Syndrome. Individuals with Williams syndrome exhibit a wide range of physical and cognitive anomalies (Bellugi *et al.*, 2000; Howlin *et al.*, 1998).[80] The cognitive deficiencies associated with Williams syndrome are mild to moderate retardation, hyperactivity and distractability, poor spatial cognition, weak arithmetical skills, and even conceptual deficits. As a result, subjects who suffer from Williams syndrome usually exhibit the cognitive capacities of a 5- to 7-year-old, and they require assistance and supervision throughout their life. From an empiricist perspective, these cognitive symptoms indicate that Williams syndrome subjects have defective learning capacities and sub-par 'general intelligence'. If language acquisition depends on 'general intelligence', it should be negatively affected and Williams syndrome individuals should have significantly impaired linguistic competence. Yet, this is not the case. A hallmark feature of Williams syndrome is surprisingly good mastery of language. Analysis of the language production of individuals with Williams syndrome shows that they have a good command of complex syntactical forms like passive sentences, conditional clauses, and embedded relative clauses (Bellugi *et al.*, 2000). In addition, their output is characterized by the occurrence of unusual and sophisticated words and the use of elaborate rhetorical devices. For example, when asked to name animals and invent stories, Williams syndrome subjects provide answers that are quite unlike those offered by individuals who are age or IQ matched. This strength in language production stands in stark contrast with the cognitive deficits listed above.

[80] Among other physical ailments, they usually suffer from cardiovascular and renal problems, delayed motor development, and hyperacusis. They also have a particular facial appearance (i.e., elfin facial features).

Smith and Tsimpli's well-known study (1995, see also Morgan, Smith, Tsimpli and Woll, 2002) of a savant polyglot called Christopher provides additional evidence against the empiricist position. Christopher has exceptional linguistic ability. In addition to his knowledge of English, his native tongue, Christopher has learned more than 15 languages, ranging from French and Spanish to Turkish, Hindi and even British Sign Language. While not perfect, his competence in these second languages is adequate to carry out conversations successfully.[81] It is also sufficient to allow him to translate in real time and with good accuracy from one language to another. Unlike most people who must work hard and long to acquire a second language, the process is amazingly easy and rapid for Christopher. Smith and Tsimpli describe how Christopher acquired a sufficient grasp of Dutch, sufficient to take part in an interview on Dutch television, in just a few weeks. What makes Christopher's achievements even more impressive is that he suffers from serious cognitive deficits. He shows symptoms of mild autism. His performance IQ is well below the average.[82] How Christopher succeeds in mastering these different languages in spite of his cognitive limitations is quite baffling from an empiricist perspective.

[81] Smith and Tsimpli (1995) note that Christopher is especially good at the acquisition of morphology and lexicon. This is striking when we examine Christopher's results in the Peabody Picture Vocabulary Test: English 121, German 114, French 110, Spanish 89 (O'Connor and Hermelin, 1991, quoted in Morgan, Smith, Tsimpli and Woll, 2002). However, syntax poses some challenges to Christopher. While his knowledge of English syntax is that of a fluent English speaker, it seems that second language syntax is always 'filtered' through English syntax, causing some anomalies.

[82] For example, Christopher scores 52 on the Wechsler Adult Intelligence Scale performance component. In contrast, he scores 98, which is the average, on the verbal component of the same test. At 29, he fails the Sally-Anne test and the Piagetian number conservation test. For an exhaustive list of Christopher's results in various cognitive tests, see Morgan, Smith, Tsimpli and Woll (2002).

Christopher's case becomes even more devastating for empiricism when we consider his performance in tasks that empiricists believe are crucial for language acquisition. In a series of tests they conducted, Smith and Tsimpli discover that Christopher's inductive capacities are quite limited and often well below those of normal individuals. When presented with an artificial language, which is organized according to relatively simple mathematical rules instead of the basic principles of human natural language (e.g., structure-dependency), Christopher is incapable of isolating the rules governing the 'language'. Hence, his extraordinary linguistic talent cannot be explained by appealing to a general capacity for the extraction patterns and principles. Christopher's uncanny cognitive ability is limited to the domain of natural language.

One last piece of evidence that goes in the same direction is found in research on children who suffer from the so-called 'chatterbox syndrome' (Pinker, 1994; Jackendoff, 1994). Chatterbox children are extremely talkative, and show impressive verbal fluency. They have a large vocabulary, which often contains unusual words, and exhibit a good grasp of grammar, which allows them to construct elaborate sentences. With respect to language, the symptoms are not unlike those found in Williams syndrome; the etiology of both conditions are very different however. While Williams syndrome is a genetic disease, the 'chatterbox syndrome' diagnosis is used for children who suffer from conditions like hydrocephaly and spina bifida. Just like children with Williams syndrome, chatterbox children have limited intellectual capacities. In Cromer's study (1994) of a chatterbox child called D.H, we learn that D.H. has low IQ score (verbal 57, overall 44). Among her other cognitive deficiencies, she has poor sorting abilities and trouble identifying patterns. Also, her perceptual uptake is below average. Here again the empiricist hypothesis predicts that D.H. should have major problems acquiring and using language. Not only does she have serious intellectual deficiencies that impact her inductive capacities, but her perceptual acuity is also diminished. Despite all of this, "we observe excellence in all aspects of her language, not only syntax, but in the phonology, semantics, and even the nonlinguistic sphere of pragmatics, that is, in the use and coordination of those linguistic skills"(1994, 151). [83]

Empiricists have tried to explain these recalcitrant facts in various ways, none of which are really convincing. One strategy consists in arguing that the linguistic competence of these atypical children is not really intact or near intact as it is often claimed. Rather, a careful analysis of their linguistic competence is said to reveal significant deficits. According to Karmiloff-Smith *et al.* (1997), Williams syndrome subjects "produce(d) relatively few clitic pronouns, frequent past tense overgeneralizations, and gender, person and number agreement errors".[84] A recent study by Grant *et al.* (2002) highlights problems with relative clause sentences. Their conclusion is that "individuals with Williams syndrome are seriously delayed in syntactic development, even into adulthood" and that "it

[83] There are other cases of dissociation found in studies of atypical children that go in the same direction. For example, research on children with Down syndrome also shows that limited intellectual capacities do not necessarily impinge on the acquisition of language. In a case study of a young woman suffering from Down syndrome, Rondal (1994) observes that impressive linguistic competence are attainable even when general cognitive capacities are affected. I should point out that this kind of linguistic achievement is somewhat atypical of children with Down syndrome. In many cases, Down syndrome causes delayed and sometimes incomplete language acquisition (Fowler *et al.,* 1994).

[84] See also Clahsen, H. & Almazan, M., 1998 for an overview of others who hold a similar position on the topic as Karmiloff-Smith.

is clear that [they] do not have intact sentence comprehension and repetition abilities".

Also supporting the hypothesis that Williams syndrome subjects have compromised linguistic competence is the work of Johnson and Carey (1998). Whereas Karmiloff-Smith *et al.* and Grant *et al*. focus on syntactic deficiencies, Johnson and Carey are concerned with conceptual or semantic deficits. They report that individuals with Williams syndrome have problems distinguishing adequately between the conceptual categories [dead], [inanimate], [unreal], and [nonexistent]. In fact, it appears that they have often only superficial, if any, understanding of the words they utter. Hence, not only would the syntactic competence of Williams syndrome subjects be below par, but their semantic competence too.

Some see these findings as supporting the empiricist model. I want to argue, however, that this conclusion is inaccurate because it rests on a faulty interpretation of the data. A more rigorous analysis of the evidence presented by Karmiloff-Smith, Grant, Johnson, Carey and others will make this clear.

To begin, I want to introduce two distinctions that will be used to shed light on the findings mentioned above. The first is between 'core competence' and 'peripheral competence'; the second is between 'linguistic competence' and 'linguistic performance'. Core competence comprises the fundamental, rule-governed aspects of linguistic competence like phonology, morphology, syntax and semantics. Peripheral competence includes other aspects that play a role in successful communication between speakers, but which are rarely rule-governed, often conventional and to a large extent arbitrary. Linguistic performance refers to the utterances that the child actually produces; language competence covers the linguistic knowledge, which typically requires a naturalistic approach to assess (Chomsky, 1986; Crain, 1991). Evidence supports the hypothesis that core and peripheral competence are independent. One can have a perfect grasp of syntax, yet have a poor mastery of pragmatic elements involved in language use. This is the case of individuals with Pragmatic Language impairment. Performance and competence can also diverge significantly. Stuttering is a good example where competence is unaffected while performance is seriously impaired. Because performance can be affected by a number of factors unrelated to deficient linguistic competence, we cannot judge linguistic competence on the basis of performance alone. Because phonology, morphology, syntax and semantics are the foundations of language, it is the level of core competence rather than peripheral competence that must be used to measure linguistic competence.

Having made these distinctions, we can reinterpret the results found in Karmiloff-Smith *et al.* (1997) and Grant *et al.* (2002). In most cases, the deficiencies alluded to by these authors are not related to core linguistic competence, but pertain to peripheral linguistic competence and performance. Consider, for example, the difficulty that Williams syndrome subjects have with past tense inflection of irregular verbs and agreement tasks for non-sense words. According to these studies, English speakers with Williams syndrome are more likely to overgeneralize the application of the regular past tense formation rule (i.e., verb stem+ed) to irregular verbs (e.g., sing => singed rather than sang). Similarly, given a non-sense word like "fadine", French speaking Williams syndrome subjects have more difficulty determining its gender than normal

French speakers. It has been argued convincingly by Pinker (2000) and others (Clahsen, H. & Almazan, M., 1998) that the mechanisms responsible for these two tasks are not part of core competence. The past tense forms of irregular verbs are not produced by a rule-governed procedure on present tense forms. Instead, we associate, by means of a mix of rote and statistical learning, the past tense forms with the present tense forms. Williams syndrome subjects difficulties with irregular past tense forms is most likely the result of deficiencies at the level of non-linguistic statistical learning capacities rather than a specific linguistic deficit with the notion of past tense. This explanation meshes nicely with what we know about the cognitive deficits of people with Williams syndrome. A similar story can be told to explain the difficulties they face with the agreement of non-sense words (Clahsen, H. & Almazan, M., 1998).

Grant *et al*. (2002) contend that Williams syndrome subjects have problems handling relative clauses, which they argue is symptomatic of broader syntactic deficiencies. It is worth considering how Grant *et al*. reach this conclusion. The protocol they used was to ask Williams syndrome subjects to repeat a set of sentences, some with and some without relatives clauses. What they notice is that Williams syndrome subjects have more trouble repeating *exactly* the test sentences with relative clauses than those without such clauses. At the same task, a normal control group performs significantly better than Williams syndrome subjects. However, Grant *et al.* notice that while they fail to repeat exactly, Williams syndrome subjects do not necessarily utter syntactically anomalous sentences. In many cases, they reformulate the test sentence, inserting an overt relative marker, where there were none initially as in (86) and (87):

(86) Test sentence: The book the pencil is on is red.

(87) Williams syndrome subject repetition: The book *that* the pencil is on is red.

This pattern of error is interesting because it shows that Williams syndrome subjects understand the syntax of relative clauses. So what *Grant et al.* demonstrate really is that Williams syndrome subjects have poor repetition ability. But this has nothing to do with core linguistic competence per se. There are a number of non-linguistic factors that could explain why they do not repeat exactly.[85] Grant *et al.* are clearly begging the question when they claim on the basis of such data that the syntax of individuals with Williams syndrome is 'seriously delayed'.

Let's turn now to Johnson's and Carey's results. I believe that the correct conclusion to draw from their results is that semantic acquisition cannot be driven by a domain-general cognitive capacity. The fact that there is clear dissociation between the Williams syndrome subjects' syntactic competence, which is excellent, and the semantic competence, which has some deficits, is evidence that different cognitive mechanisms are involved in the acquisition of both competences. If the acquisition of all aspects of linguistic competence relied on a single cognitive mechanism, how then could it be possible for Williams syndrome subjects to acquire near perfect syntactic competence, which indicates that the learning mechanism is fully operational, and at the same time acquire sub-par semantic competence?

[85] One could contest the affirmation that (87) is not exactly like (86). While the surface structure of (87) and (86) are different, one could argue that both sentences share the same underlying structure.

Hence, none of the studies examined really forces us to reconsider the conclusion that Williams syndrome is characterized by a stark dissociation between linguistic competence and other cognitive abilities. Some have challenged, for reasons similar to those put forward by Karmiloff-Smith *et al.* and Grant *et al.* that Christopher and Chatterbox children do not exhibit true dissociation. I will not provide a full explanation as to why I think this too is incorrect. I will say only that just as for Williams syndrome individuals, we can conclusively argue that Christopher and Chatterbox children have intact core competence although peripheral competence and performance are deficient.

The first empiricist objection consisted in arguing that Williams syndrome subjects, Christopher and Chatterbox children do not have intact linguistic competence. The second objection consists in pointing out that while these atypical individuals have below average cognitive capacities, those limited capacities might well be sufficient for successful language attainment, at least up to the level of linguistic competence they reach. Since young children (younger than 6) are capable of acquiring language, we can expect that cognitive capacities equivalent to that of a 6-year-old will be enough to allow someone to achieve the linguistic competence of a 6 year-old child. Individuals with Williams Syndrome (in most cases), Christopher, and D.H. meet this minimal cognitive threshold. Since a 4 year-old has an almost perfect grasp of language, we should not be overly surprised that these atypical individuals acquire almost perfect linguistic competence. Proponents of this line of defense highlight some interesting characteristics of the linguistic competence of these atypical individuals to support their hypothesis. They draw attention to the fact that the speech of atypical individuals is similar to that of a young child. Syntax is good, but not perfect. Pragmatics is usually deficient. Their production is often lacking, and comprehension is uneven. It is as if their linguistic development had stopped at the level of a young child because of their limited intellectual capacities. In other words, there is no dissociation between linguistic and cognitive competences here: the level of linguistic competence achieved is a function of the level of maturation of the cognitive mechanisms.

This explanation is not credible because it fails to account for some of the exceptional characteristics of the linguistic competence of these atypical individuals. The rich vocabulary, the frequent use of rhetorical devices, and the complex narratives of Williams syndrome subjects are rare occurrences in the linguistic output of young children. In fact, these characteristics are usually associated with the output of much older speakers. In the case of Christopher, his achievements are even beyond the possibilities of even the brightest adult minds. Rather, what these atypical individuals prove is that linguistic competence is to a large extent independent of general cognitive capacities.

There is a second kind of dissociation that empiricism cannot explain. There are individuals with fully operational sensorial apparatus, who have average or even above average intellectual capacities, who are in fact able to acquire complex cognitive competences, but who are nonetheless unable to attain full linguistic proficiency despite access to normal PLE.

The starkest example of this type of dissociation is the case of people with 'specific linguistic impairments' (SLI).[86] People diagnosed with SLI have average and even above average intellectual capacities (IQ) (Van der Lely, 1997). They have no particular sensory defects (e.g., normal hearing, normal articulation). They exhibit normal emotional states and normal social development. Even the linguistic evidence available to them during their language acquisition years is normal. All in all, they are 'normal' except for one thing: they are plagued with serious language acquisition and use problems. Acquisition is usually slower than average. In fact, many people with SLI are unable to acquire a normal mastery of language. For example, some of them have permanent difficulties with the pluralization of regular nouns like "car" ("cars") and "doll" ("dolls"). Others cannot reliably tell when the present or past form of verbs should be used. Others still are at lost when it comes to the agreement of tense, anaphora, and subject-verb agreement. In short, people with SLI appear incapable of grasping the fundamental syntactic rules governing language, rules that normal children have no difficulty acquiring and reliably applying. Oddly enough, SLI subjects often have more facility with the strictly conventional aspects of language, those that fall under the category of peripheral competence. For example, they have fewer problems with the formation of the past tense of irregular verbs.

The problems people with SLI have with some fairly basic aspects of language cannot be caused by some domain-general cognitive deficiency. Indeed, they have normal intelligence and fully operational learning capacities since they

[86] See Gopnik (1997) for a wide selection of articles on the topic.

acquire complex cognitive competences. We must conclude that the cognitive capacities that fall under the heading 'general intelligence' are not sufficient to acquire language in normal conditions. There are additional conclusions that we can draw from the analysis of SLI. The fact that their deficit is strictly with elements that are part of the core competence, while elements of peripheral competence remain essentially untouched, provides further support for the distinction between core and peripheral competence. Acquisition of core competence is made possible, one can legitimately argue, by a domain-specific cognitive mechanism, independent of more domain-general capacities like stochastic learning mechanisms that play a role in the acquisition of peripheral competence. Notice that SLI is almost the mirror image of Williams syndrome. While SLI subjects struggle with core competence yet have little problems with peripheral competence, Williams syndrome subjects exhibit the opposite symptoms. The different patterns of dissociation support the hypothesis that SLI affects linguistic cognitive capacities while Williams syndrome impairs non-linguistic cognitive capacities.

Second language acquisition is another example where we can see that normal intellectual capacities, even when ample linguistic evidence is available, are not sufficient to guarantee successful language attainment. Adults tend to have a much harder time than children when it comes to second language acquisition. Not only do their performance often lag behind that of native speakers, it is often the case that they fail to successfully internalize some core linguistic components of the second language. This is unexpected if language acquisition is indeed a function of general intellectual capacities. Adults are typically intellectually more acute than children; they have better analytical and inductive skills. These skills allow them to become proficient in very demanding intellectual fields like mathematics, physics and philosophy, all of which are beyond the grasp of children. Despite this, adults cannot match children in second language acquisition. We must conclude again that language acquisition depends on domain-specific cognitive capacities, not general cognitive skills. Furthermore, it appears the capacity for language acquisition is available only for a relative short period of time, after which it goes offline. This particular pattern of availability is additional evidence in favor of the language specific cognitive capacity hypothesis that is distinct from ‘general intelligence’.

Part 2

Externalism and Language

In the second part of my dissertation, I examine and attack another assumption that is sometimes defended, but often simply tacitly accepted, by most contemporary philosophers of language. This assumption is externalism. The hold of externalism on philosophers is extremely powerful and is matched only by the attraction of the empiricist theory of language acquisition. In Part 1, I argued that empiricism is a failed research program; I will try to argue that the same holds for externalism.

1 Defining externalism

In philosophy of language, externalism is mostly used as a label for a hypothesis about the nature of meaning. It is the claim that meanings are individuated by reference to properties of the world (e.g., microscopic structure of substances, social conventions, contingent historical facts, etc.) and not (or, at least, not merely) by reference to subject-internal properties (i.e., neural and/or computational properties that are independent of subject-external properties). The gist of externalism as a theory of meaning is best captured by Putnam's famous statement that meaning 'is not in the head' (1994) but fixed by the speaker's environment (e.g., physical, social).

What I understand by externalism in this section includes but does not limit itself to the aforementioned hypothesis about meaning. I consider the semantic hypothesis to be only one component of the externalist framework. Externalism, as I define it, provides a theoretical account of four different aspects of language:

1) *Functional aspect*: Externalism offers an answer to the question "What is the function fulfilled by language?".
2) O*ntological aspect*: Externalism offers an answer to the question "What kind of entity is language?".
3) *Epistemic aspect*: Externalism offers an answer to the question "What kind of knowledge is linguistic knowledge?".
4) *Semantic aspect*: Externalism offers an answer to the question "What is meaning?".

The distinguishing feature of the externalist position on these four issues is the assumption that satisfactory answers must be framed in terms of subject-external properties. As such, externalism stands in direct opposition with methodological individualism and internalism.[87] According to internalism (Chomsky, 2002), it is possible to elaborate a complete theory of language (i.e., a theory that deals with the functional, ontological, epistemic and semantic aspects of language) in terms of internal properties, states and processes (e.g., syntactically/internally individuated computational operations) of the speaker.

Let me stress that commitment to externalism at one level does not commit someone to adopt externalism at all levels. For example, Pinker (1994, Pinker and Bloom, 1990) is clearly a functional externalist, but he rejects ontological and

[87] I will use both terms interchangeably.

epistemic externalism. Davidson (1986) defends functional externalism and a brand of semantic externalism, but he rejects ontological externalism. Fodor (1998), at least in his latest incarnation, endorses a kind of semantic externalism, while rejecting ontological externalism. This being said, many philosophers partial to externalism tend to adopt this position for all the explanatory levels identified above.

2 Functional externalism

The commonsense answer to the question "What is the function of language?" is that it allows for communication between human beings. Language provides people with an efficient and reliable means to exchange information about the world and their cognitive states (e.g., beliefs, desires, etc.), ask questions, give orders, cause actions, take part in social rituals and so on.

Externalism does not diverge from the commonsense view on the function of language.[88] The role of language is to make communication possible. If language is fundamentally a tool for communication, it follows naturally that a theory of language will also be to some extent a theory of communication. Communication is a specific kind of social interaction. It depends on various subject-external properties (e.g., the presence of an interlocutor, a shared form of life, the principle of charity, etc.) A theory of language will have to grapple with forms of life, conventions, intentions and other externally individuated elements; it must therefore adopt an externalist theoretical perspective. An internalist theoretical

[88] It could be argued that functional externalism is really nothing more than the commonsense view under a philosophical guise (Chomsky, 1986, 2000). This conclusion holds also, I believe, for externalism at other explanatory levels.

perspective, one that focuses only on subject-internal properties, is unsuited – externalists argue—to elucidate communication and consequently, language itself.

Because functional externalism is the majority view in philosophy today, philosophers take the elucidation of communication's external conditions of possibility and its modalities of operation to be the primary task of philosophy of language. A cursory look at contemporary philosophy of language confirms this assessment.

The later Wittgenstein (2000) is one of the more important proponents of functional externalism both philosophically and historically. According to Wittgenstein, an accurate understanding of language requires that we focus on use. This is true for different aspects of language, most notably meaning. He warns us against the mistaken inclination that philosophers have to reify meanings. It is wrong, he claims, to conceptualize meanings in such a way that they are divorced from linguistic practice. Linguistic meanings are best understood not as internal psychological states or abstract entities (e.g., Fregean senses), but as the functional roles played by linguistic expressions in different 'language games'. To know the meaning of an expression is to be able to use the expression appropriately. The notion of appropriate use is socially determined; the practice of the speakers delineates what it is for an expression to be appropriately used. In other words, the social practice set the 'rules' governing the 'language game' for an expression. Taking as an example Wittgenstein's builder scenario (2000, paragraph 2), the expressions "slab" and "beam" play distinct roles; the former is used to request a slab and the latter to request a beam. One knows how to play the builder language game, and thus knows what "slab" and “beam” mean, when one utters “slab” to request a slab and brings a slab when one hears “slab” (vice versa for “beam”).

For Wittgenstein, language as a whole is a set of language games by means of which speakers accomplish various tasks (e.g., get slabs, exchange information, ask questions, etc.). Each language game has a function (i.e., ‘plays a role’) in the overall economy of the language. The builder language game has a different function than the ‘question and answer’ language game. But language as the set of all language games also has an essential function for Wittgenstein. It enables meaningful exchanges between human beings or communication.[89] It is for this reason that Wittgenstein can be said to embrace functional externalism. I will return to Wittgenstein’s commitment to functional externalism below when I examine the ‘private language argument’. I think this argument can be interpreted as an indirect defense of functional externalism to the extent that its conclusion is that we cannot understand the true nature of language unless we approach it from the perspective of humans interacting meaningfully.

[89] Two exegetical points: first, I do not argue that Wittgenstein believes that communication would be impossible without language. He recognizes the possibility of non-linguistic communication in paragraph 491 of the *Investigations* where he writes: “Not: ‘without language we could not communicate with one another’”. However, language is the condition of possibility for a specific kind of communication and this is its role our inter-subjective dealings. He goes on in paragraph 491 to say that “but for sure: without language we cannot influence other people in such-and-such ways; cannot build roads and machines, etc”.
Second, I recognize that some language games do not aim at communication. Soliloquy is a prime example. However, I believe that the very possibility of soliloquy for Wittgenstein requires that we view the fundamental function of language to be communication. The condition for understanding ‘what is said’ in soliloquy is that the person who soliloquizes takes part in communicative linguistic exchanges with other speakers in the first place. This interpretation is based on paragraph 204 of the *Investigations* where Wittgenstein writes:

> As things are I can, for example, invent a game that is never played by anyone. --But would the following be possible too: mankind has never played any games; once, however, someone invented a game –which no one ever played?

It is possible for us to play the soliloquy language game, which is essentially a private game, because we already play other language games wherein the roles or uses of the terms in soliloquy are ‘defined’: these games essentially involve inter-subjective exchanges with other speakers or what I call communication.

It is hard to overestimate Wittgenstein's influence on the development of analytic philosophy of language. Ordinary language philosophy and speech act theory are direct offspring of Wittgenstein's later philosophy both conceptually and historically. For philosophers working within the ordinary language framework and speech act theory, understanding language requires that we focus primarily on the role played by linguistic expressions in communicative settings. When we speak, our utterances are intentional acts whose purpose is to bring about certain changes in our audience. According to Grice (1994), an utterance is deemed meaningful in the linguistic sense of the term[90] if it is generated by the speaker in order 'to produce some effect in an audience by means of the recognition of this intention'. When we speak, Grice argues that we want those to whom our utterances are directed to adopt a certain attitude or accomplish a certain task, and this should be the direct result of what we have said and of the recognition on the part of our interlocutors of the implicit intentions in which what we said is rooted. This process of speaker/hearer synchronization is the essence of communication, and it constitutes the primary aim of language use (and thus, language) for Grice. And the taxonomy of speech acts that philosophers such as Searle have elaborated is the product of the analysis of the role played by different utterances in establishing speaker/hearer synchronization. An utterance U described as a 'directive illocutionary act' is an utterance that expresses the desire of the speaker S that the hearer H engage in the behavior B. In lay terminology: U must succeed at communicating that S wants H to B. Such

[90] Grice distinguishes between natural meaning and non-natural meaning. I mean by "linguistic meaning" what Grice refers to as 'non-natural meaning'.

a description of linguistic utterances highlights a commitment to the externalist paradigm.[91]

Moving away from Wittgenstein's more direct descendants, Davidson also espouses functional externalism. He states this explicitly in *The Social Aspect of Language* (1994, 11) where he argues that:

> the point of language or speech or whatever else you want to call it, is communication, getting across to someone else what you have in mind by means of words that they interpret (understand) as you want them to.

The goal of language use is communication, since communication is for a speaker to produce some kind of effect on a hearer by means of linguistic signals that are interpreted as such. Davidson's commitment to functional externalism is also obvious in his claim that linguistic interaction is best understood in terms of what he calls *radical interpretation*.

The notion of radical interpretation can be explained by means of a simple scenario. A field linguist travels to a faraway country and meets an unknown tribe. Members of the tribe emit sounds that the field linguist interprets as being linguistic, but these putative utterances do not belong to languages she knows. She decides to call this language *Jungle*. Because the field linguist is completely unfamiliar with the tribe, she has little knowledge of their beliefs, conventions, etc. Radical interpretation constitutes the attempt by the field linguist to elaborate a theory of meaning for Jungle. This enterprise is a kind of *interpretation* insofar as the field linguist tries to elaborate a theory that captures the semantic value of

[91] Other philosophers like Sellars (1971) and, more recently, Brandom (1994, 2000) work within the functional externalist framework. For Brandom, language is best understood if we consider it as an inter-subjective practice of 'asking and giving reasons' and 'keeping track of our inferential commitments'. The practice of 'asking and giving reasons' cannot be separated from communication. It is only in the context of communication between language speakers that 'asking and giving reasons' is possible.

all possible utterances of Jungle.[92] It is *radical* because the field linguist does not have the benefit of prior knowledge of Jungle or of the local population's belief system; she must start completely from scratch.

In order for the field linguist to succeed in her enterprise, Davidson argues that she must make one crucial assumption: members of the tribe are rational beings whose beliefs about what is true are largely consistent with her own. In other words, she must abide by the *principle of charity* when trying to make sense of the tribe's linguistic production. This assumption is required to 'kickstart' the process of deciphering Jungle. Without granting rationality and basic similarity of true beliefs, the field linguist would have no reason to take the tribesmen' behaviors as being linguistic, meaningful and coherent in the first place. The fact that Jungle speakers utter expression X in presence of red objects can only be considered evidence supporting the semantic hypothesis that "X means [red]" because the linguist assumes that speakers of Jungle are just as reliable, coherent and concerned with truth as she is.

But why spend so much time analyzing such a far-fetched ethno-linguistic scenario? Normal linguistic interaction does not take place in contexts that are remotely similar to the context of radical interpretation. Davidson challenges this. In 'A Nice Derangement of Epitaphs' (1986), he contends that whenever two interlocutors engage in a conversation they operate in a context of radical interpretation. Interlocutors bring to the conversation some prior linguistic

[92] According to Davidson, this theory will take the form of a list of statements specifying the extension of words and the derivation rules that generate truth condition statements based on the constituents and structure of sentences. The statements specifying the truth condition of sentences have the following structure 'S is true if and only if *p*', where S is the sentence in the object language (i.e., Jungle) and *p* is a sentence in a meta-language (i.e., English for our field linguist).

knowledge, but there is no way (and no need, according to Davidson) to determine whether this knowledge is exactly or even roughly the same for both speakers. It is for this reason that every day conversations happen in situation not unlike the one in which the field linguist finds herself. We do not know for a fact that our interlocutor shares the same language as we do. For Davidson, if two people can successfully converse, it is because they are able to converge, if only for the time of their discussion, on a common interpretative framework that he calls a *passing theory*. The passing theory is the result of the interlocutors' attempt to 'make sense' of each other in an optimal fashion. This involves, among other things, abiding by the principle of charity mentioned above.

For our purposes, radical interpretation is interesting for two reasons. First, it clearly identifies what Davidson thinks a theory of language must elucidate, namely how we succeed in interpreting linguistic utterances directed at us in a way that is consistent with the speaker's intentions. In sum, the goal is to explain how linguistic communication is possible. In 'A Nice Derangement of Epitaphs' (1986), Davidson defines language as being nothing more than the capacity 'to construct a correct, that is, convergent, passing theory for speech transactions'. This clearly identifies the primary function of language as communication. To 'construct passing theories' is to engage in a process of mutual interpretation and understanding that we call communication.

Davidson's *radical interpretation* thought experiment is inspired by Quine's *radical translation* thought experiment. The setting of Quine's thought experiment is identical to Davidson's, but Quine's field linguist has set herself the goal of developing an English-Jungle translation manual, not a full-fledged theory of meaning.[93] Commentators agree (Glock, 2003; Evine, 1991) that the outward similarities between Davidson's and Quine's scenario hide crucial philosophical differences, especially with respect to what they are supposed to prove. For Davidson, radical interpretation tells us what someone needs to do and assume in order to come to understand her interlocutor. In Quine's view, radical translation has both positive and negative consequences. It is supposed to prove that there is no way to ascertain whether two different linguistic expressions have the same meaning. This is the *indeterminacy of translation* hypothesis. To the extent that this hypothesis is correct, we can also conclude, according to Quine, that the very notion of meaning is incoherent. In 'Two Dogmas of Empiricism' (1961), Quine argues that the notion of meaning is essentially tied to the notion of synonymy. The indeterminacy of translation, however, shows that it is impossible to determine whether two expressions share the same meaning. Thus, synonymy is incoherent because there is no way to determine meaning. This –that meanings have no 'individuation conditions'—is the negative consequence of the radical translation thought experiment. The positive consequence (for Quine) is that language acquisition and linguistic communication can be explained without having to rely on intensional notions (i.e., meaning, etc.) The process of acquisition and communication must be grounded in observable evidence that is public and can be described using non-intensional concepts. Quine's anti-mentalist and pro-behaviorist views are vindicated.

---

[93] Davidson's theory of meaning is supposed to define the meaning of all linguistic expressions of a given language. For Quine, a translation manual gives for each expression of a language its equivalent in another language, but not its meaning *per se*.

It is in the light of Quine's anti-mentalism and pro-behaviorism that his commitment to functional externalism becomes clear. Language is reduced to a set of dispositions acquired by conditioning. The conditioning is supposed to have favored the acquisition of dispositions that maximize the language learner's capacity to communicate effectively with other members of the language community. He states this clearly in a recent article where he writes that "the basic function of language [is the] social sharing of information" (1997, 172; see also, 1990, 44).

Jumping back in time, I want to conclude with some remarks about Frege, whose work has influenced the semantic study of language (in philosophy and linguistics) for over a century. An essential component of his view of language is the rejection of psychologism. Psychologism, as Frege understands it, is the view that the meaning of a linguistic expression is a subjective, private mental state.[94] Frege rejects this hypothesis and argues instead that each linguistic expression can be characterized in terms of its *sense* and *reference*. The sense is that which determines the reference of a linguistic expression. Its reference is that which the sense picks out (if anything) in world. To master a linguistic expression, one must grasp its sense. Frege stresses that senses are not subjective mental states but objective (i.e., not subject dependent) and public. So, the sense [dog] is something that exists independently of speakers and can be grasped by all speakers. Why did Frege insist on the objectivity of sense? There are various

[94] It is true that Frege thinks his theory pertains only to 'perfect languages' like the symbol system of mathematics and not human natural language. But Frege's work has often been interpreted by his successors as casting light on the structure of natural language. I follow this trend in what follows.

reasons (Dummett, 1981, 67), but a crucial one is that Frege believes that objectivity of sense is needed to ensure successful communication. According to Frege, Jones and Smith can be said to communicate if and only if Jones and Smith have the very same thought when hearing the same sentence. Anything less opens the door to skepticism. One way for Jones and Smith to share the same thought when interpreting a given sentence is for them to have access to, and grasp, the same senses. Frege's objective and non-psychological senses allows for this. Hence, his anti-psychologism stems, at least in part, from his desire for a theory of meaning that is compatible with language's avowed main function, namely communication.

This rapid glance at some important philosophers of language in the analytic tradition highlights the wide acceptance of functional externalism. I could have considered Dummett, Lewis, Millikan and many others to make my case, since they all embrace functional externalism. Such unanimity among philosophers who often diverge radically on many fundamental issues is exceptional.

Perhaps because most philosophers see functionalism externalism as obvious, very few actually present explicit arguments supporting their assumption. This is not to say that no arguments are offered to support functional externalism. But they are for the most presented by linguists or cognitive scientists (e.g. Pinker and Bloom, 1990). In the next pages, I want to consider some of these arguments. A survey of the literature reveals three major arguments in favor of functional externalism: (1) the *design argument*, (2) the *adaptationist argument*, and (3) *the conceptual argument*.

2.1 The design argument

The gist of this argument is that if we examine the structural and formal properties of natural language, it becomes clear that it is 'designed' not only to enable but also to maximize communication between human beings.[95] In other words, language's design is to a large extent *optimal* for the task of communication. Quoting Sapir (1985, 7): "The truth of the matter is that language is an essentially perfect means of expression and communication among every known people". If language appears to be designed for communication, it seems legitimate to conclude that the primary function of language is communication.[96]

A look at phonology is said to reveal some of the clearest evidence that language is a tool for communication. The phonological sub-system enables the speaker to accomplish two tasks. First, it allows her to give a perceptible representation, by means of sounds or gestures, to linguistic content. Second, it gives her the possibility of extracting linguistic information from perceptible signals. Thus, phonology provides the necessary encoding and decoding algorithms to produce and interpret linguistic signals. Without it, we would be condemned to internal soliloquy. Outside of enabling communication, phonology plays no other role in the mechanics of language. Syntax, semantics, morphology

[95] Pinker and Bloom (1990) offer one version of the design argument for functional externalism. My reconstruction of the design argument is inspired by their work.
[96] As we will discuss below, natural selection is believed to be the naturalistic process that has contributed to give language this particular design.

and the lexicon are self-enclosed systems that operate independently from phonology except when they need to interface.[97]

From a design standpoint, phonological competence supports functional externalism. Particular features of human phonology further buttress this conclusion. From a design perspective, there are various ways to implement a system that encodes linguistic information into perceptible signals and that decodes perceptible signals to extract linguistic information. It is easy to imagine implementations that would be less efficient and robust than the one humans use (e.g., imagine a Morse code like phonology). However, the solution to the encoding/decoding task realized by human phonology is nothing but amazing. Indeed, the design is such that it maximizes the reception and transmission of information at a very high speed.[98] Pinker and Bloom (1990, 463) offer a number of examples of design features that contribute to efficient communication:

> The rules of segmental phonology that smooth out arbitrary concatenations of morphemes into a consistent sound pattern that juggles demands of ease of articulation and perceptual distinctness; the prosodic rules that disambiguate syntax and communicate pragmatic and illocutionary information; the articulatory programs that achieve rapid transmission rates through parallel encoding of adjacent consonants and vowels.

All these design features support the thesis that the primary function of language is communication.

[97] This is made clear by various conditions where we observe dissociation between the various linguistic sub-competences.

[98] Pinker (1994) notes that normal speech requires that we parse 10 to 15 phonemes per second. We are capable of decoding up to 45 phonemes per second. Compared with our discriminatory capacity for non-linguistic sound, these figures are incredible. Indeed, we are unable to distinguish discrete non-linguistic sounds at a rate above 20 sounds per second.

Certain syntactic features also seem 'tailored' to facilitate communication; this is seen as further evidence in favor of functional externalism. Consider the following sentences:

(1) John pondered whether he would go to school.

(2) He pondered whether John would go to school.

(3) After he went to school, John played basketball.

In sentence (1) the pronoun "he" can be used to refer either to John or to another male individual. In sentence (2), the pronoun "he" cannot be used to refer to John; it must refer to some other male individual. In (3), the pronoun "he" can be used to refer to John or someone else. As mentioned previously, all English speakers reach the same conclusions about the reference of pronouns. No English speaker would utter sentence (2) with the intent to mean (4):

(4) He (i.e., John) pondered whether John would go to school.

Cross-linguistic research indicates that the same general principle determines the domain of reference of pronouns in all natural languages. Indeed, a pronoun cannot take as its antecedent an expression that 'C-commands' it.[99]

Some see the universality of the C-command constraint on pronoun reference and the existence of other universal syntactic principles as strong evidence for functional externalism. Strict constraints governing both the use and interpretation of pronouns eliminate one source of difficulties when retrieving the

[99] C-command stands for a structural relationship that holds between constituents of a syntactic tree. A constituent X is said to be in a c-command relationship to the constituent Y if both X and Y are dominated by the same constituent Z and X and Y do not dominate each other.

message encoded in a linguistic expression.[100] Without such a precise rule, sentences like (1), (2) and (3) are semantically ambiguous because the domain of reference of the pronoun is underspecified. Without the C-command constraint, the use of pronouns would multiply the risk of miscomprehension and communication breakdown. From a design perspective, C-command is the type of constraint we expect to encounter if language is essentially a communication tool.

One last design example is case marking. Elements of a sentence fulfill specific syntactic duties and in some cases thematic duties. In all languages, there are methods used to make explicit the syntactic and thematic roles of sentential constituents; this is called case marking. In English, it is the position of a sentential component that indicates its syntactic and thematic roles. For example, the subject component is usually at the front of the sentence before the verb. Other languages rely on inflectional morphemes to indicate the syntactic and thematic roles. Nouns in ancient Greek offer a simple example. Consider the case of nouns with "–os" ending (e.g., logos). Depending on its role in the sentence (subject, object, etc.), different inflectional suffixes will be tagged to the root morpheme of "logos", namely "log-" :

[100] Below I will question the view according to which language's fundamental role is to 'encode' and 'decode' information. From the perspective of functional externalism, encoding and decoding linguistic representation to allow for communication is the essential function of linguistic competence.

Case	Singular	Plural
Nominative	o log-os	oi log-oi
Vocative	log-e	log-oi
Accusative	ton log-on	tous log-ous
Genitive	tou loy-ou	ton log-ow
Dative	to log-o	tois log-ois

From the emitter's standpoint, overt case marking is superfluous. The speaker knows what role each constituent of the sentence plays and she does not need to indicate this information overtly. The same cannot be assumed of the interpreter. In many contexts, the meaning of a sentence would be ambiguous without case markers; as a result, it becomes difficult to retrieve the intended meaning, which undermines the possibility of successful communication.[101]

2.2 The adaptationist argument

Language use is found in all human communities. Children acquire with ease a perfect mastery of the language spoken around them by the age of 4. This is true despite impoverished and unreliable evidence, differences in cognitive capacities of children, and the variations of social and material contexts in which they are raised. These observations (and others discussed in part 1) have convinced many that language depends on a specialized biological structure for its acquisition, production and interpretation. This structure is a product of the

[101] Pinker and Bloom (1990) list 10 formal features of language that they believe are optimally designed to increase the efficacy of communication. See also Jackendoff (1999) for similar comments.

universal human biological endowment and this explains the universality of linguistic competence among humans.

How such a system, which is designed for a complex cognitive task, became part of the human biological endowment is a puzzling question. For many (Dennett, 1995; Pinker, 1994; Pinker and Bloom, 1990; Dawkins, 1982) the only viable explanation involves natural selection. Unless there are good reasons to think otherwise, they contend that a biological structure that fulfills a complex cognitive function must be the product of *selection for* this cognitive function because it increases the fitness of those who possess it. In the case of language, it must be because linguistic competence increases fitness that this trait has been *selected for*, and that the *selection of* the genotype responsible for this trait occured.

If we imagine a community composed of language speaking humanoids and a community of non-speaking humanoids, adaptationists believe that the former has many fitness promoting advantages over the latter. Members of the speaking group can use language to coordinate their actions (e.g., hunting, battles), to exchange information (e.g., source of foods, potential dangers), and to create stronger communal bonds. Compared to a community of non-speakers, the speakers will have an edge in areas that are crucial for fitness with the consequence that speakers should proliferate faster than non-speakers.[102] Given how the process of natural selection works, we can expect speakers to dominate

[102] Bloomfield (1987, 268) makes points similar to those made by contemporary Darwinians. He writes: "In such ways language gives man a great biological advantage. This appears in exact cooperation in small-scale activities, such as hunting, fishing, or warding off wild animals. It leads later to the division of labor in large societies like our own. In a community of the latter kind, even the least favored individual has at his service a great variety of human performance, far beyond the strength and skill of his own body".

and their genes to become prevalent in the gene pool. The 'language trait' will spread across the species and ultimately attain fixation because there is a selection of the genotype associated with the linguistic competence phenotype. The advantage provided by language increases with the number of speakers in the community (i.e., network effect), creating a positive feedback effect that will further amplify the selection for linguistic skills.

A community whose members possess even minimal linguistic abilities is argued to have a definite selective edge over a community whose members have no mastery of language. Similarly, a community whose language is expressively more powerful should be advantaged in comparison to a community whose language is more primitive. Because a language with a greater expressive power will enable speakers to exchange even more complex information, it will have a positive impact of fitness. For instance, a simple language might limit its speakers to statements such as (5), while a more complex language would permit statements like (6).

(5) Enemies over there.

(6) Five members of the opposite tribe are close to the river.

The rationale is that since (6) conveys more information than (5), a language that generates (6) will be advantageous compared to a language that can only produce (5). Proponents of the adaptationist argument conclude that there is a constant selective pressure favoring the complexification of the language over time.

Thus, the adaptationist picture claims to explain both why and how language has become a human species trait and why it has reached its current level of design sophistication. The basic assumption made is that language is advantageous because it enables communication. The selection of the language genotype is the consequence of selection for the capacity to communicate. But if language is selected because it makes communication possible, it seems legitimate to conclude that the biological function of language is communication.

Not everyone agrees with the adaptationist story. Among its staunchest opponents, we find many philosophers (e.g., Fodor, 2000; Putnam, 1979b). However, the dispute is not about the functional claim underlying the adaptationist account. Putnam is a case in point. He does not disagree with the claim that language proves to be extremely useful to those who possess it.[103] He takes this to be obviously true. At the top of the list of the services provided by language is the capacity to communicate. What Putnam wants to resist is the move from the universality and usefulness of language to the conclusion that language is the product of a specialized biological/cognitive system that evolved for this task. Adaptationists embrace the inference. They argue that selection will favor those individuals whose linguistic capacities are hard-wired and heritable over those whose linguistic capacities are parasitical on a domain general cognitive system. Specialized cognitive and biological structures offer faster acquisition and operation, both features having a positive effect on fitness. Thus, we should expect the genes for a hard-wired language system to eventually attain fixation.

The problem with this kind of argument, Putnam contends, is that it can be used to support the existence of heritable, domain specific, cognitive structures for

[103] In fact, the structure of natural language is shaped, Putnam believes, by our basic needs and interests *qua* human beings (1979b).

a plethora of useful and universal traits that are clearly not part of the human biological endowment. For example, it proves extremely useful for one's survival to be able to use a container to drink. Without regular intake of fluid you die and the probability of passing on your genes drops to zero. The use of containers to drink is found in all human communities. By parity of argument, one could argue that 'container use for drinking' is a heritable and hard-wired skill. Most would reject this conclusion as foolish. Because the adaptationist inference can be used to support dubious conclusions, Putnam suggests that we should be skeptical of the adaptationist story about language. The fact that language is useful and universal is not sufficient in itself to support the conclusion that language is hard-wired and genetically heritable. Equally compatible with the evidence available is that linguistic competence is made possible by a domain general cognitive capacity (e.g., 'general intelligence'). The universality of language use across the human species is the result of its extreme usefulness, which insures that it is passed down generations. The fact that it allows us to communicate is crucial to the usefulness of language, and this is why it is a worthwhile investment for all humans to acquire this skill. In sum, Putnam believes that we should approach language from the perspective of cultural transmission instead of genetic transmission.

So, while Putnam rejects the adaptationist framework, he never questions functional externalism. This is typical of philosophers who are often skeptical of claims that language is a hard-wired system in the brain. In my view, the latter hypothesis is the one philosophers should embrace and it is functional externalism they should reject. We will return to this issue below.

2.3 The conceptual argument

In the *Philosophical Investigations*, Wittgenstein (2000) offers an argument against the notion of private language. I think this argument can also be interpreted as an argument *for* functional externalism. Wittgenstein's attack on private language rests on considerations about the concepts of rule and rule-following. For Wittgenstein, rules are an inherent part of language. While not the first to draw attention to the connection between linguistic competence and rule-following (see Chomsky, 2002), Wittgenstein (2000) believes that there are fundamental philosophical issues raised by the notions of rule and rule-following. For Wittgenstein (and many that followed him), we cannot hope to understand language without achieving a thorough comprehension of rule and rule-following.

Wittgenstein examines the problem of rule-following in many sections of the *Philosophical Investigations*. His discussion of this issue has been the source of much philosophical and philological debate, and there is of yet no consensus on Wittgenstein's actual position on rule and rule-following.[104] Some (Kripke, 1982) have seen in Wittgenstein's analysis an attack on the coherence of the notion of rule-following in certain contexts. Whether Kripke's interpretation of Wittgenstein is accurate is debatable; what is not is the force of the challenge that Kripke extracts from his reading of Wittgenstein. This challenge and the conclusion we should draw from it according to Kripke are what I will be concerned with in the following paragraphs.

The skeptical challenge becomes apparent when we look at rule-following from the standpoint of methodological individualism. If we adopt strictly

[104] Seymour (2005) offers a recent overview of the controversy surrounding Wittgenstein's position on rule and rule-following.

internalist standpoint, one where we seek to understand language in terms of properties 'inside the head', can we determine with certainty that someone (say, Jones) is following a specific rule R? In other words, are there some strictly internalist facts about Jones that we can rely on to know whether he is adhering to rule R or any rule for that matter?

According to Kripke, what Wittgenstein teaches us is that no such fact exists. As a result, it is meaningless to talk of Jones following a rule R from an individualist perspective. Kripke illustrates Wittgenstein's argument and conclusion using two mathematical operations: PLUS and QUUS.[105] PLUS is addition as commonly understood, namely a binary function on numbers X and Y yielding the sum of X and Y. QUUS is similar to PLUS for all numbers except for numbers bigger than 2^{12}; if X and Y are bigger than 2^{12}, the result of QUUS on X and Y is always 5.

If we restrict ourselves to those properties of Jones that are accessible from an internalist standpoint, is it possible to determine whether he is following PLUS or QUUS? Methodological individualism limits us in the kind of evidence we can rely on; we can only use Jones's past and current behaviors, mental states and physical states. Assume, for the sake of the argument, that it is possible to have access to a complete description of Jones's past and current behaviors, mental and physical states. Kripke holds that this information would not enable us to decide whether Jones is following PLUS or QUUS when asked to compute "3+5". Indeed, Jones's track record of arithmetical operations consistent with PLUS on numbers smaller than 2^{12} does not guarantee that he would still follow the PLUS

[105] My version of the PLUS and QUUS functions are slightly different from Kripke's.

rule for numbers greater than 2^{12}. Why not simply test Jones for numbers greater than 2^{12}? Such a proposal is really beside the point and shows a misunderstanding of the skeptical challenge Kripke sees in Wittgenstein's work. This solution is easily circumvented by proposing a new operation, call it QUUS^{+}, that is defined as follows: For any numbers greater that any of those added by Jones so far, the result will be 5. Thus formulated, it is impossible to decide based on Jones past arithmetical behaviors whether he is following the PLUS or the QUUS^{+} rule.

These considerations are supposed to bear directly on how we should conceptualize language because language involves rules and rule-following. The argument demonstrates that if we rely solely on the properties 'inside the head', there is no fact of the matter as to whether or not a speaker is following a linguistic rule L, L' or any rule for that matter. It would appear, then, that Wittgenstein's skeptical challenge undermines the very notion of language as a rule-governed behavior.

Is there a solution to this quandary? If we are to salvage the notion of language, something has to give. One option is to pry apart the notions of language and rule. If we can define language without using the notions of rule and rule-following, Wittgenstein's argument loses its traction. This avenue does not appear very promising however. The connection between language, rule and rule-following appears to be very strong. The other option is to see whether the problem remains if we abandon methodological individualism.[106]

[106] There is in fact a third option, namely revising the concepts of rule and rule-following. As I will argue below, there are good theoretical reasons supporting a move away from the Wittgensteinian commonsense notions of rule and rule-following when it comes to the study of language.

Kripke argues that this second strategy opens the way to a 'skeptical solution' to the initial challenge. The only way to avoid the difficulty encountered is to consider the notions of rule and rule-following from a social and normative standpoint. Whether someone is following a rule can only be settled by referring back to a community of rule-followers. Members of the community decide who they consider to be rule-followers on the basis of observable behaviors. If Jones acts consistently with the standards of the community, then he is deemed a rule-follower and a member of that community. The justification supporting the community's decision to accept Jones in its ranks is first and foremost a normative one. While Jones's behavior contributes to the decision –someone that is unable to add reliably would most likely not be admitted in the community of PLUS followers– it always underdetermines the decision. This is what Wittgenstein teaches us. While the decision is always factually underdetermined, the community's decree by which Jones becomes a member of the community is not underdetermined since it is normative and depends (by definition) only on the community's assessment. The decision of the community is the only criterion when dealing with normative judgments about rule-following.

In the case of language, whether or not Jones speaks the same language as the members of a given speech community is determined on the basis of communicative practices. If Jones and the community members are able to communicate successfully, the community will likely consider him to be a member of its linguistic group. If they do, then they are following the same rule and speak the same language.

To sum up: Wittgenstein's argument is supposed to have demonstrated the incoherence of the notions of rule and rule-following when considered in abstraction from the normative and communicative practices of a given linguistic community. The conceptual coherence of language taken as a whole requires that we conceptualize it first and foremost as a communicative practice.

2.4 The problems of functional externalism

My objections to functional externalism do not seek to prove that language is not a tool for human communication. Language is obviously *used* by humans to communicate. And while it is not the only communicative tool we have at our disposal (e.g., drawings, symbols, etc.), it is undoubtedly the most important. Human communication, and more generally human interaction, would be radically different if we did not possess language as we know it.

The position defended by proponents of functional externalism is not simply that language can be used for communication. They make the stronger claim according to which communication is the *essential function* of language. And to the extent that language has other functions, these are secondary and depend crucially on the communicative nature of language. It is possible however to hold that language is used for communication and yet deny that communication is its essential function. I think a convincing case can be made for this position. In fact, it can be shown that language's basic function is unrelated to communication and that its communicative function is ultimately parasitic on this more fundamental function. If this is correct, communication is at best a secondary function of language. Why is this issue of language's function important? By focusing almost exclusively on communication, philosophers not only fail to shed light on the fundamental function of language, but also they elaborate theories of language that overemphasize certain features at the expense others. The end result is inadequate theoretical accounts of language. To offer an analogy, the situation in philosophy of language right now is similar to the one in which biology would find itself if scientists focused exclusively on animal interaction at the expense of studying anatomy, physiological processes and genetics in their attempts to understand animal biology. It is not that animal interaction is unimportant to understand animal biology, but that focusing on animal interaction obfuscates crucial elements needed to build a cogent theory of animal biology.

Simple observations about our normal use of language offer the first reason to question functional externalism. A substantial part of our mental life is dedicated to what is commonly called thinking. The pre-theoretical notion of thinking encompasses a variety of mental processes that are arguably quite different in nature. Among the processes considered instances of thinking, many depend crucially on language. Consider deliberative and predictive thinking. Deliberation on complex issues involves more often then not the internal use of language. When faced with a problem, we work our way through it by series of reasoning and inferences that are often couched in language. The same is true for prediction: “If I do X, then Y is likely to happen. Given that Y might prove unacceptable to some, I should avoid X or at least find a way to hide Y”. Predictive thinking, in many cases, seems impossible without the machinery provided by language. Many have argued (Dennett, 1995; Hauser, Chomsky and

Fitch, 2002; Bickerton, 1995) that the intellectual capacities unique to human beings are the consequences of our use of language as a medium of thought.[107] Because language (especially syntax) allows for the coordination of concepts into more complex conceptual units, it enables us to entertain complex thoughts and trains of thoughts.

The role played by language in thinking cannot be described in terms of communication. When I use the resources provided by language to think, I am not communicating with anyone…especially not myself. The idea that thinking is a kind of self-communication is incoherent and involves a vicious regress. Furthermore, self-observation reveals that our use of language for thinking greatly exceeds our use of language for communication. Thus, from a strictly quantitative perspective, the main function of language is not communication but a tool for thinking.

This evidence is sufficient to question functional externalism. However, it is not enough to demonstrate that the primary function of language is not communication. Indeed, the use of language for thinking might be possible only because language enables communication in the first place. This is the position defended by Wittgenstein, Sellars and Dummett. They recognize the role of language in thinking, but they argue that thinking is essentially parasitical on communication.[108] Moreover, it could be argued that quantitative considerations

[107] Notice that this does not commit me to the claim that all thinking uses language as a medium. The argument that I am setting up will work even if we discover that some or most forms of thinking do not rely on language as a medium.

[108] On this issue, Dummett (1986, 470-471) writes in a paper about Davidson's 'A Nice Derangements of Epitaphs'(1986): "Language is both an instrument of communication and a vehicle of thought; it is an important question of orientation in the philosophy of language which role we take as primary. I welcome Davidson's attention to the communicative function of

are not relevant when it comes to function. For example, should I conclude from the fact that many have overestimated their commitment to training and use dumbbells as doorstops that the primary function of a dumbbell is that of doorstop? Maybe similar considerations hold for language; we mainly use it to think but its function is best understood in terms of making communication possible.

One way to strengthen our case against functional externalism is to look at the arguments put forward by its proponents. If we find them to be defective, this will be additional reason to doubt this hypothesis. Objections against functional externalism do not automatically count as evidence for functional internalism, namely the claim that language's primary function is to permit certain kinds of mental processes (e.g., thinking). While this is true, we will see that in this particular case the considerations against the arguments for functional externalism often turn out to be considerations in favor of functional internalism.

2.4.1 A critique of the design argument

Proponents of functional externalism maintain that the structural properties of human language make it extremely well suited for communication. From a design perspective, language is said to be a near optimal solution for reliable and fast transmission of information between human beings. I want to argue that a closer look at natural language's structural properties does not support this last

language, since I am disposed to take that as its primary role: language is a vehicle of thought because it is an instrument of communication, and not conversely". Dummett goes on to claim, however, that philosophers have had the tendency to focus too much on communication since Wittgenstein. Sellars makes a similar point in 'Empiricism and the Philosophy of Mind' (1963, 188) where he argues that the account he is offering "is perfectly compatible with the idea that the ability to have thoughts is acquired in the process of acquiring overt speech and that only after overt speech is well established can 'inner speech' occur without its overt culmination".

claim. In fact, its features make it optimally designed for a different purpose, namely the production of complex thoughts. Communication is really a secondary, albeit very useful, function of language. Below, I want to consider a number of design features that support the rejection of functional externalism. The argument for the connection between language and thought will be offered in Part 3.

A hallmark of human language is that it permits the production of an infinite number of discrete linguistic expressions with no upper bounds on their potential length. From a design standpoint, the unbounded character of language is at odds with its communicative function. If language were essentially a tool for communication, we would not expect its output to have this characteristic. When linguistic expressions reach a certain length, the receiver is unable to parse and understand them properly because of factors such as memory constraints. The capacity to generate indefinitely long expressions is not only useless from a communicative standpoint but it is a potential impediment. Some speakers might produce long expressions that will prove hard or impossible to parse and understand in normal contexts of communication. A system that is optimally designed for communication would set a strict limit on the length of expressions that can be generated in order to maximize comprehension and avoid memory overload. There would be limits also to the complexity of expressions that can be generated. Psycholinguistic evidence confirms that certain expressions, despite being grammatically well formed and of reasonable length, are very difficult to parse and are essentially useless for communication (Pinker, 1994). This is the case of certain sentences with multiple embedded clauses:

(7) If if if it rains it pours I get depressed I should get help.

(8) The malt that the rat that the cat killed ate lay in the house

Thus, for a system supposed to be geared towards communication, language generates an indefinitely large number of expressions that have little communicative use whatsoever.

Another design feature of human language that does not sit well with functional externalism is the prevalence of ambiguity. Ambiguity can seriously impede the success of communication. We encounter ambiguity at at least two levels. First, there is ambiguity at the level of the phonetic representation. All human languages are characterized by homonymy and synonymy.[109] There is homonymy when the same phonetic representation is associated with different meanings. We have synonymy when different phonetic representations are associated with the same meaning. Both homonymy and synonymy sometimes have disruptive effects on communication. In most cases, *quid pro quos* are either without consequences or avoided by relying on contextual information (Davidson, 1986). That we cope with ambiguity in our daily lives should not hide the fact that homonymy and synonymy make language less than optimally designed for communication.[110]

The second level of ambiguity is a consequence of the intrinsic structure of meanings. Anticipating a topic discussed in part 3, evidence suggests that linguistic meaning is not monolithic and cannot be reduced to reference, truth

[109] While there might not be perfect synonymy, the existence of near synonymy is sufficient to create problems.
[110] Frege complains about the 'messiness' of natural language and this was one impetus to elaborate an entirely explicit and unambiguous *Begriffsschrift*.

conditions, assertibility conditions oe other externalist notions. A great number, if not the majority, of linguistic expressions found in human language express abstract meanings with no obvious environmental counterparts. When such counterparts are available, they underdetermine meanings radically. A more promising approach, I believe, describes meanings as internally individuated (i.e., based on syntactic features and without reference to external properties) and multi-dimensional mental constructs that can be modulated based on the requirements of use. To clarify this idea, consider the word "newspaper". It can be used to refer to an object with a specific physical type (i.e., folded sheets of papers), an object with a specific function irrespective of its physical type (i.e., an online newspaper) or to an institution (i.e., "Harper believes the newspapers are out to get him"). The meaning of "newspaper" subsumes these radically different semantic perspectives. Similar analyses highlighting the multi-dimensionality of meanings can be offered for most human language expressions (Moravcsik, 1990; Pustojevsky, 1995; Chomsky, 2000). Now, these properties open the door to semantic ambiguity and potential communication breakdown. The ambiguity stems from the fact that a single linguistic expression can have its meaning configured differently depending on the occasion. To avoid confusion, reliance on environmental and linguistic contexts is required to elucidate what the speaker really intends. As some philosophers have pointed out (e.g., Davidson, 1986), there is no foolproof recipe for correctly interpreting a speakers' utterance given the context. We do our best to 'triangulate' the intended meaning using whatever evidence is available and by being 'charitable' with our interlocutor. An optimally designed communication system would not require interlocutors to engage in complex interpretative operations using highly variable and potentially ambiguous extra-linguistic contextual information.

At this point, it is useful to take a step back from human language to consider the general properties of systems used by animals to communicate (referred to as 'animal communication system' in what follows). When we compare animals and humans, we discover that their 'languages' are fundamentally different from a design standpoint. In a recent study, Hauser, Chomsky and Fitch (2002; see also Hauser, 1996 and Fisher & Marcus, 2006) note that animal communication systems are not characterized by unboundedness or even minimal combinatorial capacities. They lack the necessary recursive functions to produce an infinite number of discrete and potentially infinitely long expressions by means of recombination of simpler expressions. In fact, animals do not combine simple calls to make compound calls whose signification is a function of their components. This is believed to show that animal communication systems lack anything remotely similar to what we call syntax (see also Bickerton, 1995). As a rule, animal communication systems use a finite set of expressions or calls. Each call has a specific function (e.g., warning, food) and is triggered by precise environmental stimuli (i.e., presence of predators, presence of food, etc.) Unlike expressions in human language, animal calls do not have the kind of multidimensionality discussed above. Because each expression has monolithic and non-configurable meaning, there is no need on the part of animals to engage in interpretation to extract the semantic payload of a call. The use of 'gradience' can be seen as an exception to the previous generalization. Animals can lengthen or amplify a call in order to modulate its signification. For example, the call for “danger” will be louder if the danger is really imminent. Interestingly enough, human language is not characterized by gradience. Another difference is the use of iconicity in animal communication systems, which is relatively rare in human language.

The common consequence of all these features of animal communication systems is that they maximize communicative efficacy. As such, animal communication systems, not human natural language, are optimally designed for communication. A fortiori, the fact that human language eschews design features useful for communication that are present in animal systems is another reason to doubt that communication is its primary function. The differences between human language and animal communication systems raise the interesting question of why humans ended up with a system so different from other living beings on the planet. It is puzzling, from an evolutionary perspective, how and why humans have developed a system less optimal than one available to other species, some of which closely related to our own (e.g., primates). We will consider this question in a few moments. Another question prompted by our considerations on the design of human language is: Could it be that the system we describe as being non-optimally designed for communication is in fact optimally designed for another function? If this is the case, we would have a good reason to modify our functional description of language to reflect this. I think this is precisely what we need to do.

Instead of considering language as designed for communication, let’s assume that it is designed first and foremost to enable the production of thoughts. If we approach human language from this perspective, those features that seem to be design anomalies from the standpoint of communication are in fact optimal for the production of complex thoughts. The recursive nature of syntax, which is responsible for the unbounded aspect of linguistic output, makes it possible to generate increasingly complex concepts. Since concepts constitute the building blocks of thoughts, the recursive property of syntax allows us to entertain thoughts that are beyond the reach of animals. It is because of this capacity to generate complex thoughts that we are able to engage in complex activities like science and art, which are activities closed off to other animals.

If meanings are internally individuated, abstract multi-dimensional representations, this offers important benefits for the production of complex and novel thoughts. If human concepts were similar to those animals have access, our thoughts would be limited to the 'here and now'. A whole realm of thoughts would be beyond our grasp not because of lack of recursive syntactic principles to compound concepts, but because of the semantic poverty of the concepts we could work with.

Seen in this light, some of the more striking design features of human language do appear to offer a very good solution to a specific task, namely the production of complex thoughts. In fact, those very features that are potentially counter-productive for communication make complex thinking possible. In the transition from animals to humans, there has been a redefinition of the role of what is called (incorrectly given the important differences) *language*. Human language is a medium of thought. Obviously, language can also be used for communicative purposes. Yet, this role is secondary and maybe even non-essential; language would still fulfill its primary function even if it were never used for communication. Unlike humans, it is unclear that animals would benefit from their communication system if they were unable to actually communicate.

I am aware that many questions still need to be answered before my claim that language is the medium of thought is fully vindicated. First, I need to flesh out and defend more thoroughly the hypothesis that concepts are internally individuated and multi-dimensional. Second, a number of arguments have been put forward to undermine the 'natural language as medium of thought' hypothesis (Fodor, 1975; Pinker, 1994). Many believe that we need to posit the existence of a *language of thought*, which shares some important features with natural language (e.g., recursive syntax) but which is nonetheless distinct, to best explain human thinking. I will address all these questions in part 3.

2.4.2 A critique of the adaptationist argument

According to the proponents of the adaptationist argument, the emergence of human language is due to selective pressures in favor of better communication capacities. Because communication is believed to increase fitness, natural selection favored those genotypes that produced brain and cognitive structures that improved communication skills. In sum, human language is an adaptation for a specific function, namely communication.

Adaptationist hypotheses are notoriously slippery (Sober, 2000; Gould and Lewontin, 1979). They are often difficult to confirm, and one must be careful not to produce a 'just so story'. Indeed, one can always find retrospectively a function to a given trait, and then build an adaptationist story to explain its fixation. However, it would be wrong to simply discard adaptationist hypotheses because of these pitfalls. All scientific hypotheses face such hazards to some extent, and there is a way to minimize egregious errors when working from an adaptationist perspective (Sober, 2000; Dennett, 1995). The following guidelines offer some safeguards against the danger of 'just so story':

- Does the trait really fulfill the alleged function for which it is supposed to be an adaptation?
- Are the structural properties of the trait and the biological mechanisms realizing the trait compatible with the typical structural properties of traits and biological mechanisms that result from natural selection?
- Can the presence of the trait be explained in terms of different evolutionary, biological or physical processes and factors?

If we examine the adaptationist story about language while keeping these three questions in mind, we soon discover that it is quite weak. Indeed, it exhibits many of the characteristic traits of dubious 'just so stories'.

Those who defend the adaptationist position offer different hypotheses about the exact evolutionary path that led to the emergence of human language (Hauser, Chomsky and Fitch, 2002; see also Marcus, 2006 and Fisher & Marcus, 2006). One hypothesis is that human language has evolved from animal communication systems. Selective pressures are supposed to have contributed to the gradual complexification of the communication system inherited from animals until it finally reached the level of current human language.[111] There are two

[111] The view that human language slowly grew out of animal communication has a long history that predates the recent popularity of evolutionary psychology. In *An Introduction to the Study of Language* (1983, 15-16), Bloomfield writes: "It is clear, therefore, that even if one could survey the whole evolution of sound-producing expressive movements from the single cry of pain to

important points being made here. First, human language is nothing more than a more 'evolved' version of the communication systems used by animals. Animal communication systems and human language are not qualitatively different but only quantitatively different. To use an analogy, the difference between human language and animal communication systems is similar to the difference between the engine found in modern cars and the one found in the Ford T. The modern engine has a more refined design, offers better performance and fuel efficiency, but the technology used is essentially the same as the one found in a Ford T. Second, the passage from animal communication to human language has been gradual. Evolution has progressively refined the communication system of proto-humans until it reached its current state. The end result is the product of steady tinkering on the communication system used by our evolutionary ancestors.

Another hypothesis describes the evolutionary path leading to human language as involving the massive overhauling of the kind of system used in animal communication and the addition of radically new structures unique to human beings (Pinker and Bloom, 1990). According to this view, human language constitutes an entirely different piece of 'cognitive technology' when compared to animal communication systems. To use the engine analogy again: the difference here is between a combustion engine and a jet engine. While there might be some structural similarities between both kinds of technology, they are nonetheless radically different both in operation and performance. Human

which some animals are limited, up to the present speech of man, there would be no point at which one could say: Here language begins […] This, indeed, is why it is impossible to set up a strictly logical definition of language as opposed to expressive movement in general". Quine defends the same view in *From Stimulus to Science* (1995, 22).

language is argued to have appeared gradually through the selection of independent features that individually offered selective advantages. For example, Pinker and Bloom (1990) contend that subjacency might have been selected for independently because it improves significantly by itself the efficiency of communication. So, human language evolved in a piecemeal fashion with new features being added progressively.

Both these evolutionary stories face serious problems. In the case of the first hypothesis, the fundamental structural differences between human language and animal communication systems highlighted in the previous section constitute strong evidence against it. Recursion cannot arise through progressive modifications and refinements of functions found in animal communication. Indeed, nothing in animal communication systems is even remotely comparable to recursion (Hauser, Chomsky and Fitch, 2002). As such, there is no clear upgrade path from features found in animal communication systems to recursion by means of gradual evolutionary tinkering. A similar conclusion can be reached when we compare many meanings in human language and functions of animal calls. Here too the difference is one of kind and not simply of complexity.

Bickerton (1995) mentions other problems with the first evolutionary path. Humans have retained the capacity to communicate like animals do. Screaming, crying, laughing, facial expressions and other non-verbal behaviors are human equivalents of animal calls. They are automatically triggered by environmental stimuli and usually involve immediate behavioral response (i.e., fleeing, etc.). Furthermore, human calls share a number of other features with their animal counterparts like gradience, iconicity, non-recursivity, etc. Human language has none of these characteristics as indicated above. Bickerton argues that it is unlikely that the very same cognitive system could be responsible for both language and non-verbal communication given their antagonistic properties. It seems more plausible to assume that we are dealing with two different systems that are to a large extent isolated.

Additional support for this conclusion comes from cases of dissociation where individuals retain their linguistic competence but lose their capacity to use and interpret non-verbal signals like screams, laughs, etc. that are closely related to animal calls. This is sometimes the case of people afflicted by mild form of autism called Asperger's syndrome. One characteristic of people with Asperger's syndrome is a serious difficulty using and interpreting non-verbal signs (e.g., body language, facial expressions, different gazes, etc.), many of which are part of the 'human call system' corpus. Consider the case of facial expressions. Most humans easily interpret a person's attitude on the basis of her facial expression. In fact, humans are generally able to read someone's feelings simply by looking at their gaze. There is good evidence that this competence is to a large extent innate. Individuals with Asperger's syndrome are often unable to reliably 'read the mind' of people using facial cues (Fitzgerald, 2004; Baron-Cohen, 1997, 2003). It has been observed also that there is often a mismatch between the facial expressions of Asperger's individuals and their own feelings. If language was intimately connected with the human call system, we would expect Asperger's people to show noticeable linguistic deficits. Interestingly though, Asperger's people do develop near perfect linguistic competence (i.e., syntax, phonology). Where they diverge from normal individuals is with respect to their *use* of language, which is sometimes odd. For instance, Baron-Cohen (2003, see also Tager-Flusberg, 1994) observes that Asperger's individuals have difficulties with conversational conventions, correctly assessing what they can assume their interlocutors know and their current intentional states. But these problems are best understood in terms of a deficient 'theory of mind' on the part of Asperger's individuals and not in terms of deficient linguistic capacities. If their linguistic competence were indeed defective, we would expect to find significant syntactic, morphological, phonological and semantic anomalies. It is not the case however.

As for the second evolutionary path, it also faces serious problems. The claim that individual features like subjacency could be selected for because they increase fitness by allowing more efficient communication does not hold water. First, it is unclear that taken individually features likes subjacency would really improve the capacity to communicate. As Bickerton (1995) points out, a language that implements randomly chosen syntactic features might not lead to improved communication. In fact, the opposite seems to be true. The output of such a mongrel language would be harder to interpret, especially from the standpoint of speakers who do not have access to the same linguistic features.

Bickerton also alludes to another source of evidence that contradicts Pinker and Bloom's proposal. If the human language evolved in a gradual fashion, with each stage characterized by better communication and increased fitness, we would expect to see signs of this in the human fossil record. Increasing capacity to communicate would have led to a progressive increase in social activity that should correlate with a progressive transformation of the fossil record over the years. However, paleontological evidence reveals that before the appearance of our own species (*Homo Sapiens*), which arguably possessed full linguistic skills from the very beginning, the *Homo Erectus* lifestyle stagnated for over a million and a half years at a level much below that of the *Homo Sapiens*. Thus, the progressive evolution of language that Pinker and Bloom hypothesize led to no significant difference in the lifestyle of *Homo Erectus* but proved decisive in shaping the *Homo Sapiens*' reality. This is rather odd. It is always possible to argue that language only became truly useful for our ancestors when it reached a certain level of complexity. But if this is the case, the hypothesis that the incremental complexification of language offered selective advantages at each stage is incorrect.

Pinker and Bloom also assume that language is a complex structure built out of independent functions (e.g., subjacency) that come together into a coherent system. Recent work by Chomsky (1996) indicates that human language might well be much simpler than initially thought. According to the 'Minimalist program', syntax can be reduced to one operation: Merge. What distinguishes different human languages is reducible to features of lexical items and a few parameter settings. If this hypothesis is correct, one crucial premise of the adaptationist argument is invalidated, namely the complexity of language. Furthermore, if human language depends on a few simple principles, the progressive constitution of language by means of selection of linguistic features, each individually adaptative, becomes less plausible. Language might well have appeared in a catastrophic way as a result of a mutation. Such a hypothesis also has the benefit of fitting with the paleontological data (i.e., sudden explosion of cultural artifacts at the time the *Homo Sapiens* came on the scene).

The minimalist hypothesis offers other reasons to be skeptical of the Pinker and Bloom adaptationist account. If minimalism is correct, language is both an extremely simple and formally elegant computational system that is optimally designed to interact with other systems of the mind (Chomsky, 2002). Such structural properties are not what we expect to encounter if language is the product of cobbling different elements in a piecemeal fashion. As Jacob (1982) describes, evolution works by 'tinkering'. Evolutionary solutions are rarely economical or optimal because of all the constraints on natural selection. For one, selection can only start from traits that are currently available. This imposes limits on the kind of adaptations that can emerge. Developmental, biological and physical constraints also play a limiting role. As a result, selection cannot be expected to generate the best solution bar none, but only the best solution given the constraints present (Sober, 2000). But in the case of language, it appears that we have a structure that is optimally designed and simple. Most likely, then, human language is not the result of evolutionary tinkering, but must have emerged by means of other biological processes. As mentioned above, maybe a single mutation was sufficient to produce human language as we know it. We will return to these questions in the last part of the dissertation.

So far, I have examined problems undermining various evolutionary paths by means of which language is said to have appeared. All these proposals assume that language was selected because it facilitates communication, which increases fitness. Now, I want to turn my attention to this assumption. There are two crucial problems with it. First, it is unclear that increased communicative capacities would have increased the fitness of our ancestors given the context in which they lived. Paleontological data (Bickerton, 1995) indicates that *Homo Erectus* lived in closed communities with little contact with other *Homo Erectus* groups. As a result, there was little competition between groups with different genetic makeup and minimal gene flow between populations. Recall that the adaptationist argument claims that increased capacity to communicate would have allowed better communicators to dominate groups composed of less proficient communicators. This is said to have contributed to the progressive improvement of human language and its fixation among humans. The paleontological data is incompatible with the adaptationist story. Since there was arguably little competition between *Homo Erectus* populations, better communication capacities would not be an important differentiating factor with respect to fitness. Indeed, non-speaking *Homo Erectus* would not be at a great disadvantage because they rarely had to compete with speakers because there was enough space and resources for everyone. In other words, we do not have a context conducive to the so-called ‘arm race’ (dixit Dawkins) that would drive the gradual development of language. Furthermore, because there was little gene transmission between groups, it is hard to see how the genes needed for complex language would have attained fixation among our direct ancestors. Could it be the case that language was advantageous because it enabled better intra-community communication? Given the high biological costs (i.e., energy, maturation, etc.) associated with the development of a high-level cognitive capacity like language, it seems unlikely that there would have been strong pressures for the selection of such a trait. In the context in which our ancestors lived, traits like increased strength or speed would have offered much greater selective advantages and would have been favored over language.

A number of points made in the design argument discussion are also relevant here. It was noted that human language is not optimally designed for communication. Design solutions implemented by other species, some of which are humans' direct ancestors, arguably fulfill this task more efficiently. As a result, it is difficult to understand from an adaptationist perspective why humans evolved the kind of communication system they did if selective pressures favored communication capacities. In addition, one can ask why no other species evolved a communication system similar to human language if it proves so beneficial for survival. If the selective pressures strongly favor the type of system that is human language, we would expect to see other species implement something similar either as a homolog or analog. A comparison with the evolution of visual organs proves useful here. The adaptative advantages of possessing some kind of visual apparatus are obvious. It allows for a more effective interaction with the environment, a better capacity to avoid predators, etc. There are many examples of visual organs, quite similar in design, in a variety of species that are often quite distant on the evolutionary scale (Hauser, Chomsky, Fitch, 2002). The prevalence of visual organs in different species is evidence supporting the hypothesis that there are enormous selective pressures for the evolution of visual systems. Adaptationists argue that human language offers equally large adaptative benefits, yet we do not find genuine analog or homolog in other species. This is puzzling.

Two conclusions can be drawn at this point. First, it seems highly unlikely that human language could be the product of natural selection given its structural properties. Human language does not exhibit the characteristics of a system built by 'evolutionary tinkering'. Second, there is no obvious selective pressure for human language as an adaptation for communication. But if language is not an adaptation, does this not entail that language cannot be part of our biological endowment and must be explained using a non-naturalistic framework? Indeed, is not natural selection the only process by means of which a trait can enter a species' biological endowment? Some like Dennett (1995) and Pinker (1994) would like people to believe this. Even if the adaptationist story is not fully convincing, Dennett and Pinker argue, if one is committed to naturalism then she must embrace the adaptationist account since the only other option is a non-biological and non-naturalistic theory of language. Since most people cannot resign themselves to accept the latter, they embrace the former even if the case for this hypothesis is spotty at best. But Dennett and Pinker are setting up a false dilemma. The choice is not between adaptationism and 'mysticism' to paraphrase Dennett (1995). There is a third option that is entirely naturalistic and compatible with our best scientific knowledge of biology and evolution. *Contra* Dennett and Pinker, natural selection is not the sole engine driving evolution, and Darwin's theory of evolution cannot be reduced to adaptationism

From an evolutionary standpoint, two important questions can be asked about human language:

- How did the trait appear?
- How did the trait reach fixation?

In answer to question 1, Chomsky (2002, 2005) and others (Bickerton, 1995) have argued that emergence of the distinguishing feature of human language, namely recursion, could possibly be the result of a single mutation. The addition of recursion to the cognitive capacities already available to our direct ancestors would go a long way in establishing the core of human language. Missing would be the rich concepts that humans can access. Recent studies in primatology show that non-human primates possess a relatively rich conceptual system in some domains (Hauser, Chomsky and Fitch 2002). One hypothesis offered to account for the conceptual differences between humans and primates is that we have the capacity to connect concepts from different cognitive systems (e.g., vision, theory of mind, etc.) to generate richer concepts (Hauser, Chomsky and Fitch, 2002; McGilvray, 2005a). The possibility of different cognitive systems interfacing in a novel way –a kind of decompartmentalization of the mind's faculties—is also something that could be the result of genetic mutations.

Another hypothesis offered by Hauser, Chomsky and Fitch (2002) is that there might be a primitive recursive mechanism already at work in non-human species. However, this mechanism does not interface with the conceptual resources of non-human animals, but is used for other purposes like navigation or communication. For instance, the communication system of bees possesses some features associated with unboundedness (Chomsky, 2002). Bees indicate the location of food sources by means of a flight pattern ('dance') that varies based on factors such as the distance of the food source from the hive. Technically, the bees' communication system can generate an infinite number of different dances to express the infinite number of food source locations. This capacity to produce new 'calls' on demand might involve a primitive recursion engine.[112] What happened with humans is that an analog or homolog of this recursion engine can now interact with our richer conceptual resources to produce complex concepts. This is a relatively simple change that could be the result of a single mutation but whose consequences are extremely far-reaching.

These two hypotheses about the emergence of human language are not adaptationist, but they are nonetheless evolutionary accounts. Mutations are robust biological phenomena, and adaptationists depend on them to introduce the trait diversity required for natural selection to start its tinkering. Without mutations, natural selection would have little material to work on. While adaptationists can disagree with the suggestion that human language is the result of a limited number of mutations, they are wrong when they say that such an account goes against modern biology and that it is nothing more than 'crypto-creationist' (Dennett, 1995). In fact, it is the radical adaptationists who are turning their back on modern biology[113] and Darwin when they systematically fail to consider non-adaptationist hypotheses.

The second question, "How did the trait reach fixation?", does not necessarily require an adaptationist answer either. The following scenario offers a plausible explanation of the evolution of language that is not adaptationist. It

[112] A crucial difference between the recursion of human language and the 'recursion' of bee dance is that the former is applied to discrete elements (i.e., linguistic expressions) and generates discrete elements (i.e., linguistic expressions) that differ in discrete ways (i.e., components, syntactic properties, semantic properties). This is not the case of bee dances that differ in a non-discrete way.

[113] For example, the research done in the Evo-Devo research program shows that the phenotype is the result of a multitude of biological constraints that go beyond those acknowledged by adaptationists. For a recent overview of the findings in the Evo-Devo field, see Carroll, Grenier and Weatherbee (2004) and Carroll (2005).

might have been the case that the genes responsible for linguistic competence are linked to genes that offer a significant increase in fitness. For example, language genes might be linked to genes offering protection from a deadly endemic disease that kills before individuals can procreate. In such a situation, the fixation of the genes for human language is the product of natural selection. However, it would be incorrect to claim that there has been a *selection for* human language (Sober, 2000). While there has been a *selection of* genes responsible for language, it is the resistance to the deadly disease and the genes responsible for this that have been *selected for*. We are justified to talk of adaptation only with respect the disease resistance phenotype and genotype.

This is an entirely fictional scenario. However, it exemplifies one possible evolutionary path for the fixation of human language that does not assume selection for improved communication capacities. The problem with adaptationists is that they reject for methodological reasons the very possibility that significant traits like language might have achieved fixation for reasons other than their adaptativeness. This kind of a priori methodological bias is unacceptable in the context of a naturalistic inquiry.

It should be clear that I am not arguing that it is impossible for language to have reached fixation because it was selected for and constitutes an adaptation. Instead, I defend the following two points. First, I am stressing that language could have achieved fixation even if it did not constitute an adaptation in itself. Second, if language did reach fixation because it is an adaptation, it is unlikely that it was *selected for* because it improves the capacity to communicate. A much more likely adaptative story (Bickerton, 1995) for the fixation of language is that it gave our ancestors the capacity to entertain complex thoughts, which in turn enabled them to solve complex problems. The capacity to solve complex problems gave those among our ancestors with linguistic competence a clear advantage. As a result, the survival and the reproduction of linguistically competent individuals increased substantially leading to the fixation of the trait.

While this adaptative story supports my claim that language's primary function is thinking, I do not put too much weight on it. As it stands, there is very little in terms of evidence that can be marshaled to support or confirm this (or any other) adaptative account concerning language. Because there is no sense in peddling another indemonstrable 'just so story', it is best to focus our efforts on other questions. This is the position that Lightfoot (1991) and Chomsky (2000, 2002) have defended, and it still seems to be a sound methodological approach.

2.4.3 A critique of the conceptual argument

The conceptual argument states that we cannot make sense of the concept of rule outside the normative context provided by a community. To say that "Jones follows rule R" means that Jones is recognized to abide by R by a community of reliable followers of R. Whether Jones is a R-follower is determined by a normative judgment on the part of the community. A determining factor in the community's decision is whether Jones can successfully communicate with speakers of the community. If one adopts methodological individualism, talk of rule and rule-following becomes empty because these notions cannot be coherently defined internally. There is simply no fact of the matter, (Kripke's) Wittgenstein holds, on the basis of which we can determine whether Jones is following R, another slightly different rule R' or any rule at all.

The Wittgensteinian analysis is presented as an attempt to clarify our commonsense and largely inchoate grasp of what rules and rule-following behaviors are. It does not seek to create new concepts or to revise those we already possess in order to build a theory that would 'explain' language. Language does not need to be explained and cannot be explained by a theory, Wittgenstein believes. It does not need to be explained to those that speak it because they already know everything there is to know about the language: they know 'how to play the language games'. And to those who 'do not know the language', 'how to play the language games' cannot be grasped by means of theory; linguistic knowledge is an ability, a know-how, that is acquired by means of training. Despite Wittgenstein's claim to the contrary, I argue that his account of language constitutes a *theoretical explanation* of what it means for language to be a rule-governed competence. His description of rule and rule-following might be rooted in common sense, but it goes beyond mere 'clarification' into the domain of theoretical explanation. To claim otherwise is disingenuous given the sophistication and non-triviality of Wittgenstein's conclusion. Whenever we encounter an explanation, we are entitled to ask whether it offers the best understanding of the phenomenon it seeks to explain. What I want to argue is that we can achieve a better understanding of language as a rule-governed competence by adopting different notions of rule and rule-following than those proposed by Wittgenstein. By revising these notions and divorcing them from common sense, we make significant heuristic gains.

The notion of rule I believe we should adopt when trying to understand language is defined in computational terms. On the account I offer, a rule can be individuated without making any reference to social practices and communication. Its individuating properties are entirely subject-internal. Rule-following, in this context, is not a normative notion but an empirically ascertainable property of a computational system.

Because philosophers often mean very different things by 'computation', let me clarify what I mean by this word. At the most fundamental level, a computational operation is a mapping relationship[114] of input values to output values that is sensitive only to the formal (i.e., syntactic) properties of input and output values. In the context of the linguistic computational system, the input and output values are internally individuated mental objects. By 'internally individuated', I mean that what distinguishes a mental object A from a mental object B is *not* that A and B differ in how they relate to things or properties external to the computational system itself. A and B are distinct mental objects because of the inherent features of the computational system operating over them. A description of computational mental operations, as I understand it, will not be concerned with how the operations can be put to use in specific environmental contexts by real persons, but only with the computational possibilities of the system taken apart from instantiation. For example, we seek to discover: the input/output mapping relationships that are realized by the system; the kinds of

[114] The 'mapping relationship' can involve multiple steps and require operations over intermediate expressions. For example, computational operations that generate a question sentence according to the extended standard model of generative grammar (X-bar theory) take an input value (a declarative sentence) and map them via transformations on an output value (a question sentence.)

input values that are compatible with the computational system; the kinds of output values that can be generated by the system; the steps that are involved in the mapping operations. My approach to computation is essentially the one favored by Marr (1982).[115] In *Vision*, Marr offers a computational and mathematical description of a computational system that happens to be used for vision by humans. The fact that the system is used for vision (an externalist and contingent fact) does not play a role in his analysis of the computational properties of the system (an intensional enterprise). Chomsky adopts the same approach when dealing the computational properties of the language faculty.

Some elements of my account of computation are at odds with the standard computational theory of the mind. Indeed, the received view links computation and the representational theory of mind (e.g., Fodor, 1998; Rey, 1997). For the computational approach to shed some light on the workings of the mind, it is usually believed that mental objects over which computations operate must systematically 'stand for' or 'refer to' non-internalist properties. I think this is wrong. Philosophers committed to the representational theory of the mind (henceforth, RTM) have made little progress in solving difficult questions about the mental because the computational account they offer rely essentially on externalist notions (e.g., referential and alethic notions). In contrast, those thinkers like Chomsky and Marr who have rejected RTM have made significant

[115] Whether Marr's account of the visual system is an internalist and intensional theory is controversial issue. Some argue that his theory should be interpreted from an externalist perspective, while others claim that the externalist interpretation is incompatible with Marr's fundamental project. What is clear is that Marr's theory allows for a strictly internalist and intensional interpretation. This is the one I adopt.

advances describing and explaining the computational properties of certain mental subsystems like vision and language. I provide evidence for this in part 3.

We can use the concept of computation outlined to generate revised definitions for rule and rule-following. The set of operations by means of which a particular input value is mapped on a particular output value is called a 'function' of a computational system. From a computational perspective, *rule* is defined as a *function*. A function describes the operations that the system carries out given a specific input value. While this is a theoretical revision of the concept of rule, the computational concept is not entirely alien to its commonsense counterpart. The lay-notion of rule refers to constraints on behavior based on certain conditions. The notion of rule-following is also revised in the light of the concept of function. A computational system that instantiates a particular function F when it encounters an input value V can be described as 'following the rule F'. Two computational systems that do not carry out the same function given the same input value do not 'follow the same rule'.

The computational approach provides a powerful tool to understand the nature of language and linguistic competence. Speakers generate outputs, linguistic expressions that have non-random properties. For example, English speakers append "-s" to singular nouns to produce the plural form. Regular verbs receive the suffix "-ed" when they are used in the past tense. Starting from the observation that speakers produce linguistic expressions with non-random properties, we try to discover what are the resources available to speakers that enable them to generate a linguistic production (i.e., output values) with these particular characteristics. One explanatory strategy consists in positing the existence of computational processes in the speaker's mind that produce the linguistic output. One hypothesis would be to assume that a computational system in the speaker's mind instantiates the functions (9) and (10):

(9) Regular verb + inflectional morpheme "ed" = Past tense form.[116]

(10) Regular noun + inflectional morpheme "s" = Plural noun.

These functions are operations over internally individuated variables ("regular verb", "regular noun") and constants ("+ed", "+s") that generate outputs ("trains", "watched"). If we adopt the revised idiom proposed above, we can say that the speaker 'follows the rules' (9) and (10) since these describe the functions instantiated in the computational system responsible for the linguistic output.

On the computational account I am advocating, it is an empirical issue which computational functions a system instantiates. There is ultimately a fact of the matter as to whether or not a given computational function is realized. We discover what computational processes are at work in the mind in the same way physicists discover the principles governing the physical world. We use abductive reasoning on empirical evidence and follow general heuristic principles (i.e., simplicity, fruitfulness, accommodation with other disciplines when possible) to come up with the best computational description possible. Returning to the examples above, the analysis of the linguistic production of a typical English speaker (let's call him Jones) leads us to assume that functions like (9) and (10) must be at work. Other factors might bring us to modify or even reject either (9)

[116] Obviously, "regular verb" and other expressions in this function must be understood in a strictly internalist fashion. It is only from the perspective of language use that "regular verb" stands for regular verbs, etc. This relationship does not contribute to individuate the expression or the computational operation in which the expression is found.

or (10) as being part of Jones' computational system. For example, (9) might prove incompatible with other elements of Jones' internalist computational organization that are strongly supported. (9) might be discarded because it can be replaced by or reduced to more general computational processes.

Whether Jones instantiates (9), (10) or other computational functions can be fully ascertained without taking into account non-individualistic factors like the judgment of members of Jones' linguistic community. It is not a normative question whether Jones' mind operates according to (9) or other functions, but a strictly empirical issue similar to whether a given physical system is governed by a principle X or a principle Y. The community's judgment of Jones' performance might be used as *evidence* to support one computational hypothesis over another. However, the community's judgment does not play the role of *criterion* to determine which computational functions are instantiated by Jones.

Obviously, the computational approach sketched above and the hypotheses it yields are worthwhile if and only if the mind is a computational system. Like all empirical hypotheses, the internalist computational theory of mental systems like language and vision cannot be deductively proven and might even turn out to be wrong. However, the work in philosophy of mind and cognitive sciences over the last 60 years has shown that the computational paradigm constitutes the best theoretical framework to describe and explain the operations of the human mind. No other research program comes even close to matching the heuristic and explanatory power of the computational approach. Behaviorism is basically dead in the water, while connectionism fails to account for high-level cognitive processes. Inference to the best explanation supports the hypothesis that the human mind operates computationally because it offers the 'loveliest' hypothesis (Lipton, 2004).[117]

Proponents of the Wittgensteinian picture are bound to reject my proposal. Because it is a move away from common sense, it is viewed as distancing us from the putative goal of philosophy of language, namely clarifying the commonsense notions of language, rule and rule-following. While my proposal is a move away from common sense, it needs to be demonstrated why this is problematic. I do not think Wittgensteinians succeed in doing this; their commitment to common sense is an article of faith. In the end, heuristic fruitfulness should decide between the Wittgensteinian approach and an approach that discards commonsense concepts in favor of theoretical constructs. Part 3 is an attempt to show that the latter approach is indeed superior.

A more pressing objection is that I simply side-step Wittgenstein's skeptical challenge. Indeed, how do we know with certainty that Jones is realizing the computational functions (9) and (10), rather than different computational functions that are extensionally equivalent to them? Quine (1960, 1990) makes a similar point when he discusses the problem of indeterminacy. He points out that an infinite number of grammars are equally compatible with any given set of linguistic utterances. Because the only source of empirical evidence available about a speaker's language are her utterances, there is no fact of the matter as to which grammar, out of all the extensionally equivalent grammars, is actually instantiated at the computational level. Since there is no way to overcome the

[117] Is the inference to the best explanation sound? Addressing this question in detail would take us too far from our main topic. We find in Lipton (2004) a solid defense of the inference to the best explanation's soundness.

radical indeterminacy given the empirical evidence available, we should refrain from postulating the existence of computational processes. In fact, we should reject the entire mentalist framework (computational or other) and limit ourselves to an explanation of mind and language in terms of behavioral evidence. This is what the 'naturalization of philosophy' requires.

As Chomsky argues repeatedly (1980, 1986, 2000), the Wittgensteinian/Quinean skeptical argument is the latest incarnation of an unwarranted metaphysical and methodological dualism that is still prevalent among contemporary philosophers. Contemporary philosophy has essentially dismissed Cartesian substance dualism. Physicalism –the thesis that there is only one kind of substance, namely physical substance—stands virtually uncontested (but see Chalmers, 1997; Nagel, 1974). The central problem of philosophy of mind—on the received view—is therefore to offer a convincing account of how physical substance can give rise to the mind. Clearly, while substance dualism went the way of the phlogiston theory and other scientifically dubious claims, the same cannot be said of metaphysical and methodological dualism. Many philosophers, whether explicitly or implicitly, still consider the mental to be metaphysically distinct from the physical. As a result, one cannot study mental phenomena using the same methods used for understanding physical phenomena, namely the naturalistic/scientific approach. When it comes to the mind –and, by extension, language—we must adopt a philosophical approach characterized by deference to commonsense concepts, intuitions, and methodological behaviorism. The standards for an adequate explanation of the mental are not those accepted in naturalistic sciences, but are specific to the philosophical enterprise. A philosophical explanation of the mind is limited in the kind of evidence it can rely on; only the evidence with the right kind of 'philosophical pedigree' is suitable.

Only if we accept methodological dualism can the objections of Wittgenstein and Quine gain traction. All empirical disciplines are confronted with the problem of underdetermination of theory by evidence. Hypotheses in physics and in all other 'hard sciences' are attempts to provide the best explanation of 'why things are the way they are' given the empirical evidence available and various formal constraints that scientists feel should be respected (i.e., simplicity, accommodation with other disciplines.) Interesting scientific theories posit the existence of processes and entities that are not directly observable but only inferred in order to yield the most comprehensive and fruitful explanations. All scientific hypotheses are necessarily inferential in nature and never achieve absolute certainty. Yet, this situation does not lead most scientists to adopt either the anti-realist stance or an extreme skepticism about scientific theories. To the extent that they are successful, most see these theories as describing the world as it is.

So, why are 'hard sciences' not straddled with skeptical attacks of the sort opposed to computational theories of language? Put differently: why are the standards imposed on the computational account of language so different? A computational account of language is nothing more than an attempt to explain our linguistic competence by positing the existence of underlying computational processes. Using all evidence available, we attempt to elucidate the structures and the operations necessary for language. To the extent that the hypothesis 'saves the phenomena' and meets the basic requirements of a good naturalistic theory, then we can conclude that it describes how language works. New evidence or considerations might force us to change our theory in the future, but this is the predicament of all naturalistic endeavors.

It could be argued that I am unfair to Wittgenstein and Quine when I claim that their skepticism is nothing more than the consequence of some implicit allegiance to metaphysical and methodological dualism. Quine does offer an argument as to why the issue here is not one simply of underdetermination but of *indeterminacy*. Quine recognizes that it is possible for two different theories in physics to be equally supported by evidence. However, he argues that these two theories necessarily differ on at least one of their ontological commitments. As a result, it becomes possible (in principle at least) to determine which theory is the correct one once we have completed the ontological inventory of the universe. When it comes to mind and language, the situation is different. Quine argues that the only evidence available to decide between two extensionally equivalent grammars are the linguistic utterances produced by the speaker. Yet, *ex hypothesis*, this evidence confirms both grammars equally! This is unlike the situation faced in physics; this is indeterminacy and not underdetermination.

Quine's argument assumes that we accept methodological behaviorism, which states that we can only rely on observable linguistic behavior as evidence for a theory of language. But why should we limit ourselves to this class of evidence? There is no principled reason, except the kind of methodological dualism mentioned above, one that justifies such a narrow evidential base. If we widen the kind of evidence used (i.e., acquisition considerations, elicitation tests, neurobiological data, developmental data, etc.), it becomes possible to eliminate extensionally equivalent grammars on empirical grounds. One needs only to consider the progress in linguistics to see this process at work. As such, Quine's argument fails to prove that there is indeed a crucial difference between the computational hypothesis about language and other scientific hypotheses when it comes to underdetermination by evidence. Consequently, nothing justifies a greater skepticism towards the former.

A second objection to the revised notion of rule can be drawn from the work of Burge (1979) and Putnam (1994). Imagine that there are two communities, A and B, that are alike in all respects except for one minor detail. In community A, speakers take the word "sciatica" to mean [a pain in the sciatic nerve]. In community B, speakers take the word "sciatica" to mean [a pain in a nerve]. Now, consider the case of Smith. Smith is a member of community A, and thus equates "sciatica" to [a pain in the sciatic nerve]. When he uses "sciatica" while communicating with members of a community A, he is deemed to be a rule-follower for "sciatica" by other speakers because he fulfills the required normative conditions. If Smith were to move to community B, Smith's status *qua* rule-follower is supposed to change radically. With respect to speakers of community B, Smith is not considered to be a rule-follower. His speech behavior is deemed anomalous. Now, Smith is in the same computational state when using "sciatica" whether he finds himself in community A or B. But depending on his location, his status as a rule-follower is reversed. Conclusion: different rule governed behaviors can supervene on the same computational processes.

I think this argument can easily be deflected. *Ex hypothesis*, Smith instantiates the same computational process when uttering the word "sciatica" in communities A and B. His location does not affect his computational operations understood internally. At a computational level, Smith can be said to realize a specific computational function *qua* rule. If we remain at the computational level, the status of Smith *qua* rule-follower is exactly the same in A and B. The fact that communities A and B diverge in their *assessment* of Jones *qua* rule-follower might be correct, but it does not affect the truth-value of the observations made at the computational level.[118]

The last objection I want to consider concerns the idea of 'unconsciously following a rule'. The description of the mind as a computational system posits the existence of functions that are not accessible by introspection and that are at odds with the commonsense description of the mind's operations. For some philosophers (Wittgenstein, 2000; Searle, 1980, 2002, 2004; Bloor, 1997), 'unconscious rules' and 'following a rule unconsciously' are non-sensical ideas. Let me focus on Searle's argument on this issue. First, he believes that we can only talk of 'rule' if it can be brought to the subject's consciousness and be followed consciously. This does not seem to be the case for computational rules. While I might be able to bring them to consciousness (e.g., by reading books that describe the computational operations of the mind), computational rules are not the kind of rules that a human being can follow *qua* person.[119] Second, there

[118] Pietroski (2005) makes a similar point but from a different perspective.
[119] Searle writes: "So, for example, in cognitive science it is commonly said that a child learns a language by "unconsciously" applying many computational rules of universal grammar, or that the child is able to perceive visually by performing "unconscious" computational operations over the

cannot be genuine rule-following if someone is not conscious of *actually* following the rule and that her rule-following is the reason behind her current action. A science fiction scenario can be used to illustrate the second objection. Imagine that, unbeknownst to him, Jones is under the control of some evil scientist. The evil scientist controls Jones such that every time he encounters a dog he sneezes. The opponents of unconscious rules argue that it would be false to say that Jones is following the rule 'sneeze when I encounter a dog' since he is controlled and is not willfully acting according to the rule. Since we stand in the same relationship with computational rules like Binding theory as Jones does with the rule 'sneeze when I encounter a dog', we cannot be said to be following the computational rules posited by linguistics. The third problem is intimately connected to the second. If someone could follow a rule without being aware of it, then we cannot refer to this rule to *explain* the person's behavior. A legitimate explanation must tell us *why* a person does what she does. In other words, the explanation provides us with the *reasons* for someone's actions. But the reason why Smith does X cannot be 'he is following the rule computational R' since R is unconscious, and by definition, he does not know that he is following this rule. Thus, we cannot rely on unconscious rules to provide reasons and explanations of human behavior. For all these reasons, Searle holds that we can only describe a computational system as exhibiting 'pseudo rule-following behavior'.

---

input that comes into the child's retina. In both these cases, both in the acquisition of language and the forming of perceptions, the computational rules are not the kind of things that could ever be consciously thought". (2004, 241) If these rules cannot be thought, it ensues that they cannot be followed either.

Despite Searle's contention, all these objections can be circumvented. The argument according to which one cannot be following an unconscious rule is not very convincing. The crux of the first argument is a commonsense intuition elicited by means of a science fiction scenario. From the commonsense perspective, someone cannot be 'following a rule' if one is under the control of somebody else. Yet, the first question we need to ask is why should we take commonsense intuitions to be reliable guides to understanding the human mind and language *qua* natural objects. Philosophers rely on them frequently (e.g., Putnam, 1994; Kripke, 1980), but rarely justify their legitimacy. Furthermore, recent research has shown that intuitions that are often believed to be obvious and universal by philosophers are not. They are cultural artifacts that are products of the philosophical intellectual enterprise (Machery, Mallon, Nichols and Stich, 2004). As a result, these intuitions alone have limited values when the goal is to discover the nature of the mind and language.

That commonsense intuitions should be treated with skepticism is a principle that is held as a truism in most naturalistic disciplines. For instance, consider the relationship between folk physics and theoretical physics. Folk physics is the physical theory that we rely on spontaneously when apprehending the world around us. No one believes that theoretical physics should mirror folk physics. But why do most philosophers fail to make the same distinction when it comes to folk accounts of mind and language, and theoretical accounts of mind and language? Why is the former taken to set the boundaries of the latter? If we adopt the computational account of rule described above and if we define rule-following as the property of a system realizing computational functions, and if such an account allows us to better understand language, then why not adopt the idiom according to which 'Jones is following the rule of Binding theory when using anaphor'?[120]

Similar considerations can be used to deflate Searle's other objections. Searle's commonsense intuitions about rules, rule-following and the possibility of unconscious rules are nothing more than *his commonsense intuitions* (or those of certain philosophers working in a certain tradition of philosophy). The only reason why we should feel bound by them is if they contribute to the best and most fruitful explanation of mind and language and not because they are commonsensical. To the extent that they fail to meet the former condition, then we have no obligation to abide by them.

3 Ontological externalism

Ontological externalism is a metaphysical thesis about the nature of human language. Proponents of this view argue that language is a *social and historical artifact*. By *artifact*, they mean that language is a human creation rather than a natural object whose essential properties are largely independent of human actions and decisions. It is a system of conventions put together by humans to permit communication. The conventions specify the fundamental attributes of language: sound/meaning pairings, grammatical rules, etc.

[120] And for all it is worth, my intuition and that of many people I have polled (sample set: 13) is that if we can show that Jones understands an utterance U as meaning M because his brain implements the C-command constraint on pronoun reference, then the constraint is a rule and Jones is indeed following it. Furthermore, my little survey indicates that people believe that reference to C-command constraint on pronoun reference to explain *why* Jones speaks the way he does is legitimate.

Advocates of ontological externalism claim also that language is a *social* artifact. They understand this in two ways. First, language is said to be the result of a collective process of creation; it arises out of social interaction. To quote Putnam (1992, 25): "Language is a form of cooperative activity, not an essentially individualistic activity". It is social in a second sense, ontological externalists contend, insofar as it is nothing more than the sum total of the actual speech acts of the community. Unlike a monument that achieves independent existence after having been built by a group of people, language is indistinguishable, the argument goes, from language use itself. For this reason, language is best defined as being an 'institution' or a 'form of life', to borrow Wittgenstein's terminology.[121]

Lastly, language is an *historical* artifact for ontological externalists. While it might be impossible to pinpoint when a social group created a language, every human language is nonetheless a historical entity with a particular diachronic development. Historical contingencies, (e.g., choices by members of the community at a certain time, etc.) explain why the language of a community has its particular characteristics. These contingencies are the only constraints on human natural language, which can technically vary 'without limit' according to ontological externalists.[122] From this perspective, language can be seen as the repository of a community's history. It is assumed also that the diachronic development of language is gradual. Changes are slow and incremental in order

[121] Bloomfield (1987, 267) makes a similar point when he writes 'language unites individuals into a *social organism*' [emphasis in the text].

[122] Martin Joos claims that 'languages could differ from each other without limit and in unpredictable ways'. Sapir defends a similar position: 'language is a human activity that varies without assignable limit'. Williams Dwight Whitney talks of the 'infinite diversity of human speech'. All quotes are from Chomsky (1986, 20-21).

to ensure continuity and maintain the possibility of communication. They are more likely to occur at the periphery than at the core of the language; core conventions are deeply entrenched and they are more 'costly' to change.

Ontological externalism, like functional externalism, has numerous advocates among philosophers of language in the analytic tradition. Here again, the philosophical influence of Wittgenstein is undeniable. He has contributed greatly to the elaboration of the ontological externalist position, and since then others have sought to improve and defend it. In the discussion of functional externalism, I mentioned how for Wittgenstein language is best understood by means of an analogy to the concept of game. A game is a rule-governed practice; it is essentially conventional in nature. Rules governing a game are not only human creations, but they can only exist if there is a social recognition that they are indeed rules (i.e., authoritative and binding). In all these features, language is similar to a game. It is a collective practice governed by conventions that were freely invented by humans.[123]

Wittgenstein's defense of language as a social 'institution' (2000, paragraph 199) is part of his critique of the philosophical approach that seeks to subordinate language to some ideal structure, and thus, to drive a wedge between language and language use. Wittgenstein defends a version of the 'idealist' view in the *Tractatus* (1985) where he tries to explain natural language through the

[123] In paragraph 492, Wittgenstein (2000) writes: "To invent a language could mean to invent an instrument for a particular purpose on the basis of the laws of nature (or consistently with them); but it also has the other sense, analogous to that in which we speak of invention of a game. Here I am stating something about the grammar of the word "language", by connecting it with the grammar of the word "invent"."

prism of formal logic.[124] Frege can also be interpreted as advocating a similar position insofar as he sees natural language as an imperfect representation of an ideal language. According to the 'late' Wittgenstein (2000), we must reject the view that natural language is somehow tethered to an ideal logical language. This view rests, he claims, on serious 'misunderstanding' (2000, paragraph 81). Logic and natural language are distinct human practices, both of which are human creations. Each has its distinct and irreducible purposes. Logicism fails to recognize this important fact.

The idea that language is fundamentally historical is also developed in Wittgenstein's work. He captures the language's diachronic development by comparing it to the development of a city:

> an ancient city: a maze of little streets and squares, of old and new houses, and of houses with additions from various periods; and this surrounded by a multitude of new boroughs with straight regular streets and uniforms houses. (2000, paragraph 18)

A language is a hodge-podge of language games, each with its own peculiar features and quirks. Some language games have a long history, while others are recent extensions of the linguistic practice of the community. By examining the historical development of language, we can learn something about how the community has itself evolved (i.e., it interests, projects, etc.)[125] Wittgenstein claims that new language games are significantly different from the older ones; they exhibit a 'regularity' and 'uniformity' that are absent from more primordial language games. Despite their different character, language games from all

---

[124] In paragraph 4.0031, Wittgenstein states: "All philosophy is "Critique of language" (but not at all in Mauthner's sense). Russell's merit is to have shown that the apparent logical form of the proposition need not be its real form".

[125] See also Bloomfield (1987, 268)

epochs coalesce into a relatively coherent whole, showing that linguistic evolution tends to accommodate new and old.[126]

The very first sentence of *Word and Object* (1960, ix), 'language is a social art', leaves no doubt about Quine's position. By choosing the word "art", he puts the emphasis on the fact that language is a practice that was and is created by humans. Like Wittgenstein, Quine warns us against the temptation to reify language in such a way that it is distinct from the behaviors of actual language users. This is, at least partially, his target when he attacks what he calls the 'myth of the museum'. For Quine, language literally 'floats in the open air' (1990, 44); language is nothing more than the practice of uttering certain sounds in certain contexts. Ontological externalism is a crucial component of Quine's philosophy of language. It is one of the major premises of his argument against intensional notions like meaning. Indeed, if language is nothing more than observable behaviors, we are forced to recognize the indeterminacy of translation, the incoherence of synonymy and the impossibility of specifying the notion of meaning. This leads Follesdal (1995, 53) to write "Quine, more than any other philosopher, has made us see the far reaching implications of the public nature of language".

Davidson, unlike Wittgenstein and Quine, is ambivalent with respect to ontological externalism. In 'A Nice Derangements of Epitaphs' (1986), he

[126] Seymour (2004) claims that Wittgenstein is not committed to the existence of language but merely language games. Thus, Wittgenstein would be an ontological externalist about language games and not about language *per se*. Unlike Seymour, I do not think we should interpret Wittgenstein as rejecting language as a genuine ontological entity. By bringing together diverse language games, a language gives rise to something that is more than the sum of its parts, namely a form of life. A form of life genuinely exists. If we simply focus on independent language games, we lose sight of this.

attacks the idea that language is a set of public conventions shared by speakers. Without going into details, Davidson's argument can be summarized as follows. First, he shows that conventions cannot be devised without using the resources of language. Thus, it cannot be the case that conventions are constitutive of language. Second, if linguistic competence is reducible to the mastery of definite linguistic conventions, then we should have serious problems dealing with malapropisms, metaphors and other linguistic occurrences that diverge from conventional usage. Yet, we rarely encounter such difficulties. Based on these observations, Davidson concludes that the idea that language is a set of public conventions must be incorrect. This leads him to argue that there is really no such thing as *language* as commonly understood. There is no institution in which all speakers of a linguistic community participate. Instead, individual speakers possess the necessary competence to interpret other speakers successfully and be understood by them correctly (see also, Davidson, 1997). This competence is not strictly linguistic. In fact, it is the very same capacity that enables us to deal successfully with the different challenges that the world throws at us every day. In a linguistic context, this capacity is used to move from our current linguistic theory (i.e., 'prior theory' for Davidson) to a 'passing theory' upon which interlocutors agree and which is used to generate and interpret linguistic utterances in this specific communicative context. Except for the passing theory that they share momentarily, interlocutors do not have a common language *per se*.[127]

[127] According to Glock (2003), Davidson is not forced to deny the existence of natural languages like French and English. Glock (2003, 254) claims that "[A]t stake is only the idea that such a

A case could be made that one of the main reasons Davidson's recent philosophical work has caused so much controversy is precisely because it undermines the received view of ontological externalism. Many philosophers, some who were well-disposed towards his initial research program have refused to follow Davidson down the path he has taken in 'A Nice Derangements of Epitaphs'. To borrow Dummett's expression (1986; see also Hacking, 1986), many have 'recoiled' from the conclusion that there is no such thing as shared public language possessed (or partly possessed in the case of Dummett) by all members of a speech community. Dummett, Putnam, and many others have continued to defend ontological externalism despite Davidson's objections.

3.1 Arguments for ontological externalism

Philosophers of language and some linguists have developed a variety of arguments to support ontological externalism. As we will see, some of the arguments used to defend functional externalism are also relevant here. I will not repeat my detailed descriptions of them but simply point out how they bear on the present issue. Those arguments that are specific to the question of ontological externalism will receive a full discussion.

3.1.1 Linguistic diversity and diachronic development

Ontological externalists are impressed by the differences between human languages. They see this putative formal diversity as confirming their hypothesis

---

language amounts to a set of precise and specifiable rules, shared knowledge of which both is necessary and sufficient for communication between its speakers". But given Davidson's argument, the ontological status of natural languages like French and English is quite puzzling. At best, they seem to be idealizations with little philosophical or scientific value. One wonders why Davidson would want to keep them around.

that a language is a set of arbitrary conventions upon which a community has agreed either tacitly or explicitly.

The most striking case of linguistic diversity is the complete arbitrariness of sound/meaning pairs. As mentioned in our discussion of the design argument, human language does not rely heavily on iconicity as a means to express meaning. While we find some expressions that are iconic (e.g., onomatopoeias), there is no connection between the phonetic form and the meaning of the vast majority of linguistic expressions. *Dog*, *chien*, *hund*, etc. do an equally good job at conveying [dog]. The assumption, which fits with the ontological externalist picture, is that each sound/meaning pair is the result of an arbitrary choice made by members of community at some point in time. Once the initial choice was made (i.e., *dog* will stand for [dog] from now on) the sound/meaning pair is passed down to everyone introduced to the linguistic practice.

Ontological externalists press their point by considering other examples of diversity. Take the case of word order. The standard English sentence has a Subject-Verb-Object (or SVO) word order; the subject is at the head of the sentence, the verb follows, and the object occupies the last position. Obviously, English allows for different word orders (i.e., “Because of the rain, John decided to use his car”), but SVO construction is the default. Cross-linguistic evidence reveals that SVO order is not used in all languages. We find almost all possible permutations of S, V, and O among human languages (Baker, 2001): OVS (Hixkaryana, Warao), VSO (Arabic, Welsh), SOV (Abkhaz, Quechua), VOS (Malagasy, Tzotzil). Moreover, certain languages show a high degree of configurational freedom (e.g., Warlpiri) allowing different word orders. There is no evidence that choosing one type of word order over another provides linguistic benefits. They are all equally suited to express human thoughts. If syntax is largely arbitrary and conventional like ontological externalists believe, such a proliferation of word orders is not surprising. In fact, it is to be expected. Each community settled upon a canonical word order at some point in time, and it became entrenched in the linguistic practice. Because there are no benefits in choosing one rather than another, different communities ended up adopting radically different word orders.

If linguistic diversity is undeniable, there are properties, especially basic structural features and linguistic categories, that are shared by all human languages. For instance, all languages have elements that behave like nouns, verbs and adjectives (Baker, 2003). How can ontological externalism account for this? Putnam (1979b) offers two hypotheses. First, cross-linguistic similarities might be caused by our shared biological and social needs. For example, Putnam claims that having nouns, verbs and adjectives proves incredibly useful for the kind of beings we are. In short, the usefulness of certain conventions explains why historically unrelated groups have chosen them. Notice that non-linguistic constraints (i.e., usefulness) are ultimately responsible for linguistic features. Putnam thinks that it is conceptually and biologically possible to imagine a community that would create a language whose basic categories are radically different from those we use. However, this would not be a pragmatically wise choice.

Putnam's second explanation for cross-linguistic similarities is historical. If we assume that all human languages can be traced back to a single primitive language used by the first community of language users, this could explain why languages today share some similarities, especially with respect to basic structural properties. Because these properties are likely to have been some of the first to be adopted, they became deeply entrenched. They constitute the matrix out of which all other languages have evolved. If we accept this story about the evolution and transmission of language, there is no tension between ontological externalism and the presence of cross-linguistic similarities. We find similarities because some conventions have been passed down generations and have survived the process of differentiation that generated the different human languages.

Historical linguistics data can be interpreted as corroborating Putnam's view. Indeed, there is solid evidence showing that historically related languages tend to share more similarities. Contemporary Romance languages (e.g., French, Italian, Spanish, and Romanian) are often cited as examples. All of them can be traced back to their common ancestor, Latin, and this common ancestor exhibits many features that Romance languages share. The differentiation of Latin into Romance languages is traced back to contingent historical events (immigration, war, etc.) that caused the splintering of the Latin speaking community. Ontological externalism predicts that the process of differentiation occurred gradually in order to maintain a minimum of continuity that is required for the language to remain a useable tool of communication. Linguistic practices changed gradually 'in a piecemeal fashion' and with 'no major discontinuities' (Lightfoot, 1999, 82-83).[128]

3.1.2 Ontological and methodological considerations

Ontological parsimony demands that we choose the 'leanest' ontology possible. We should only introduce a new entity in our ontology when it becomes clear that we cannot offer a satisfactory explanation without it. As a methodological principle, it protects us from spurious scientific and philosophical explanations that might save the phenomena but nonetheless fail 'to carve nature at its joints'.

For some (Quine, 1960), one of the major benefits of ontological externalism is its ontological parsimony. Communicative behaviors are readily observable around us. As such, they are already part of our ontology. For ontological externalists, language is nothing more than the sum total of these communicative behaviors. Language is not some additional entity whose existence is posited over and above the community's practice of language use: language is the practice itself.

Those who are inclined to consider language as an entity distinct from linguistic behaviors are prey to what Quine calls 'the fallacy of subtraction' (1960, 206). It is the illegitimate propensity to infer the existence of abstract properties and entities from the existence of particulars. For instance, based on observations like "The book is blue", "The sea is blue", "The pair of pants is blue" and other observational statements containing the word "blue", some

[128] Lightfoot (1999, 82-83) writes that '[T]he overwhelmingly most common view among historians is that language change is gradual' and that '[G]radualism has pretty much had complete hegemony'.

conclude that the property BLUE exists independently of blue entities. However, such an ontological commitment is neither necessary nor desirable, Quine argues. When we say that “X is blue”, the predicate indicates that the X is a member of a particular set (i.e., blue things) and nothing more. Now, when we affirm that behavior B is part of language L, what this means is that behavior B is part of a set of behaviors that is labeled ‘language L’. Language L is not something that exists independently from the set of behaviors labeled ‘language L’.

Ontological parsimony can be used as a benchmark to compare hypotheses. On this count, proponents of ontological externalism think that their position is superior to alternatives like linguistic Platonism and linguistic mentalism. The problem with these alternatives is not only that they impose a richer ontology, but also that the entities they posit are highly questionable. Consider the case of linguistic Platonism (i.e., Frege, Katz). Language is defined as an abstract entity distinct from the linguistic practice of language users. To borrow Frege’s terminology, language exists in a ‘third realm’ that is contrasted with the inner realm of subjective representations and the outer realm of perceptible objects. For many, the idea that language is an abstract entity found in a ‘third realm’ is problematic both ontologically and epistemologically. What kind of entity is language precisely? Where is this third realm? How do we relate to language given its ontological properties? Compared to the claim that language is the practice a community of speakers engages in, linguistic Platonism seems unnecessarily complicated.

Linguistic mentalism holds that language is a mental object (i.e., a grammar) in the speaker’s head. Outward linguistic behaviors are only the 'symptoms' of language *qua* inner mental object. For Quine, one reason we should reject mentalism is that it sins against parsimony. To the extent that we can provide a complete explanation of language based strictly on observable behaviors –and he thinks his philosophy shows we can—then we should reject mentalism. Furthermore, because infinitely many different grammars are extensionally equivalent to a given set of linguistic behaviors, talk of language being internally represented by a specific grammar is empty.

Considerations related to Wittgenstein's 'private language argument' are also believed to highlight another serious problem plaguing linguistic mentalism. As we saw, the argument is supposed to show that language necessarily belongs to the normative sphere. In defending the hypothesis that language is a mental object, mentalists fail to recognize this basic fact.

Wittgenstein's fundamental problem with mentalism can be presented in a slightly different way. What is wrong with mentalism is that it makes a 'category mistake'; it confuses language and the internal processes upon which language supervenes. The following quote captures the distinction that Wittgenstein thinks mentalists overlook (1989, paragraph 302):

> What should we say to someone who would tell us that *for him* understanding *is* an internal process? –How could we counter him if he claimed that for him "knowing-to-play-chess" is an internal process? –Essentially this: that nothing happening inside him is of interest to us when we want to know if he knows how to play chess. And if he answers that we are nonetheless interested by what is happening inside him, namely whether he knows how to play chess –the only objection that would remain would be to remind him of the *criteria* that would prove his capacity to us.[129]

[129] See also paragraph 293 in Wittgenstein (2000).

Because mentalism is confused about the nature of language, it ends up confusing the goals of philosophy and science too. Dummett (1996) and Soames (1984) make this point. According to them, philosophy seeks to describe and understand language *qua* human practice. As such, philosophy has no interests in neurology and psychology.[130] The neuropsychology of language is an entirely different project with a distinct object; what it studies is really the brain and not language.

There is one last reason why ontological externalism is believed to be the better position. For many philosophers, publicity is a non-negotiable feature of language. For the like of Frege and Dummett, what guarantees the success of communication is the fact that language is public and it can be shared by all members of a linguistic community. Frege posited objective senses as a way to fulfill the publicity condition. Ontological externalists do not need to have recourse to such an extreme measure. Because language is the linguistic practice of the community, language is *ipso facto* public.

3.2 The problems of ontological externalism

When analyzed systematically, one discovers that a number of serious problems plague ontological externalism. In the following pages, I will examine the problems that I consider to be the most damaging to this view.

In *Knowledge of Language* (1986, see also 2000), Chomsky asks whether language understood as a socially and historically defined institution (or *E-language* in Chomsky's terminology) is a theoretically sound and empirically

[130] The following quote gives a fair idea of Dummett's position: "A meaning-theory should not, therefore, aspire to be a theory giving a causal account of linguistic utterances, in which human beings figure as natural objects, making and reacting to vocal sounds and marks on paper in accordance with certain natural laws. We have no need of such a theory". (1991, 91-2)

robust object of inquiry. The central problem with the notion of E-language is that it does not possess rigorous individuation criteria. There is no way to provide a robust description of a putative E-language that would enable us to distinguish it in a principled way from other putative E-languages. Boundaries between E-languages are entirely arbitrary, which completely discredits language *qua* institution as a legitimate object of philosophical and scientific inquiry.

To support this claim, let's examine some of the criteria used to individuate E-languages. E-languages are often individuated on the basis of alleged formal differences (i.e., phonological, syntactical, lexical, morphological and/or semantical). So, Quebecois French is considered a distinct E-language from France's French because of its idiosyncratic characteristics. However, what is called 'Quebecois French' subsumes linguistic practices that are far from homogeneous. Inhabitants of Gaspésie do not speak like those of Montreal. There are substantial differences in formal properties (especially lexical and phonological) between these incarnations of Quebecois French. Equally important linguistic differences can be identified when we compare people belonging to different socio-economic classes in Quebec. If differences in formal properties justify that we distinguish Quebecois French from France French, it seems then that what is called 'Quebecois French' is really a motley of distinct languages. In fact, a rigorous E-language taxonomy based on formal differences would need to be much more fine-grained. The 'Quebecois French' language that I speak is perceptibly different from the languages spoken by other speakers in my community. My 'Quebecois French' has a number of unique characteristics (e.g., the way I pronounce "macaroni" or the meaning of "justice") that are the results of the interaction of a multitude of factors that range from my personal history to my distinctive biological constitution. Thus, if we want our taxonomy to track formal linguistics properties, there would need to be as many E-languages as there are speakers. Obviously, this conclusion undermines the very notion of E-language. A language that is possessed by only one speaker cannot be an institution shared by members of a community. Nor can such a language be considered public in any relevant sense.

Is it possible to avoid the pernicious regress that undermines the coherence of E-language? For instance, could one decide to ignore some linguistic differences between different speakers to prevent the proliferation of idiolects? I want to argue that ontological externalists will find no relief in this approach. Consider English E-language defined as the common language of English communities in North America, Europe, Australia, Caribbean, India, etc. Clearly, this E-language is an abstraction (i.e., we abstract from the different dialects); no one speaks this abstract form of English. In that sense, it is not a genuine E-language anymore; it does not capture the practice of any group of individuals. But also we need to explain why we stop abstracting at the level of English E-language. Why not go on and abstract English E-language in favor of a more general E-language like Germanic E-language (i.e., an E-language that would encompass German, Danish, Flemish, Dutch, etc.) or Indo-European E-language? There are no principled reasons that exclude this.

It could be argued that the right level of abstraction is determined on the basis of epistemic and heuristic fruitfulness. While overly abstract E-languages support few enlightening generalizations, an E-language that adequately abstracts away from irrelevant differences will offer a rich source of linguistic insights. Just as sciences study idealized objects, philosophers of language do the same when they consider E-languages. What they analyze are idealized institutions (i.e., the idealized institution of English). There are at least two problems with this line of defense. First, the study of E-languages, whatever the level of abstraction chosen, has generated no significant body of knowledge compared to approaches that rely on a different ontological concept of language (i.e., internalized language or I-language). E-language linguistics offers little more than partial behavioral descriptions (Chomsky, 1986). But more importantly, E-language linguistics rarely offers scientifically cogent explanations of linguistic phenomena. When confronted with phenomena like referential patterns of pronouns and anaphora or the semantic properties of linguistic expressions, E-language linguistics offers explanations in terms of conventions and analogy. Not only are both notions extremely vague and explanatorily shallow in this context, but much more cogent theories are available that provide non-trivial explanations. Insofar as the value of an idealization depends essentially on its epistemic and heuristic fruitfulness, the notion of E-language fails miserably. It can be argued that the reason why E-language fails to support substantive scientific discoveries is because it fails to refer to a real natural object (Chomsky, 2000). This is the second problem with E-language. Successful idealizations track real natural objects. This is why they can sustain generalizations and can enter in causal explanations. But E-languages, with their arbitrary boundaries, do not track robust natural objects. At best, they track sociological or historical epiphenomena that cannot be used as foundations for a cogent theory of language.

Some try to resist the argument against E-language by appealing to our common sense and intuitive understanding of language *qua* social and historical institution (Dummett, 1996b). Chomsky (2000), among others, shows why appeal to common sense is a non sequitur. The fact that we talk as if there were such things as 'shared public languages' does not entail that there are such things. To use one of Chomsky's examples, we do talk about the sun rising and setting, but this does not commit us to the view that the sun actually rises and sets. We know that the sun's rising and the sun's setting are epiphenomena resulting from our particular standpoint with respect to the sun, and nothing more. E-language, Chomsky argues, is also an artifact and an epiphenomenon. The use of the notion is quite acceptable when we remain at the level of commonsense discussions about language. However, it does not yield a robust theoretical understanding of language. Theories of E-language are just like theories about sunsets; they provide no theoretical insight. It is true that we can learn much about a given culture's commonsense cosmology by investigating its commonsense beliefs about the sun. Such an investigation does not amount to science about the sun, but to ethno-linguistic inquiry about the culture. Similarly, research on E-language can potentially provide us with sociological information about a community of speakers, but little more.

There are other methods that could be used to individuate E-languages than those we discussed so far. One could decide to adopt a genealogical criterion. Linguistic institutions that are historically related constitute a single E-language. Individuation is based on lineage in this case. Individuation could be made using successful communication as a criterion; speakers who can effectively communicate linguistically share the same language. Finally, historical and political factors could be taken into account. Before the implosion of Yugoslavia, Croatians and Serbs were described as speaking the same language. Since the war in this country, Croatians and Serbs insist that they speak different languages. None of these proposed individuating factors can save the notion of E-language from the objections examined above. In fact, they introduce additional difficulties. The genealogical account yields a taxonomy that papers over some crucial linguistic differences and obfuscates important linguistic similarities. For example, many Creoles share important linguistic traits (Bickerton, 1999), which would justify considering them as constituting a distinct language class. Yet, many Creoles are historically unrelated. Communication does not constitute a reliable criterion to individuate languages either. Indeed, 'successful communication' is an irremediably vague notion. What is 'successful communication'? I can often communicate successfully with Italian speakers using French. Should we say that Italian and French are the same E-language? What about the fact that I run into a communication breakdown when discussing with people who are usually described as English speakers (e.g., religious conservatives)? Are we speaking different languages? Lastly, political and historical factors are orthogonal to linguistic considerations. The fact that a government or an institution (e.g., French Academy) adopts a certain linguistic taxonomy does not necessarily tell us something relevant about language *qua* natural object. The linguistic taxonomy is informative about the sociological, political and historical context. A good example of this is the recent controversy about Ebonics. Some pontificated that Ebonics is not a fully-fledged human language and that it should not be taught in schools or promoted for this reason. This position is the consequence of a specific political and sociological worldview; it does not rest on a sound scientific understanding of what language is. Philosophers and scientists who aim to achieve a true understanding of language cannot be limited by political and sociological prejudices that have no robust theoretical foundations.

I want to turn my attention to considerations that undermine the view that human language is entirely conventional, and characterized by gradual and contingent transformations in time. Proponents of ontological externalism refer to these putative properties to support their claim that language is a social and historical artifact. The problem is that an increasing body of evidence (Lightfoot, 1984 and 1999; Roberts and Roussou, 2002) contradicts the hypothesis that 'languages could differ from each other without limit and in unpredictable ways' (Joss) and that linguistic change is arbitrary and gradual. First, I want to focus on the question of conventionality, and afterwards I will discuss diachronic linguistic transformation.

If human language exhibited 'free variance', there should be noticeable diversity in the kind of linguistic conventions governing different languages. Just as the sounds used to express concepts vary widely from one language to another, linguistic principles should also exhibit striking variations. If we examine human languages in a cursory fashion, it is tempting to conclude that they do vary greatly and that they do so arbitrarily (e.g., word order variations, etc.)

But it is incorrect to conclude from such observations that languages are strictly human conventions. While there are some elements that are indeed arbitrary and conventional, the vast majority of linguistic principles (e.g., syntax, phonology, morphology and even semantics) governing human languages are not conventions that vary freely and without constraints. A rigorous analysis shows in fact that the potential 'forms' that human languages can exhibit are very limited.

Supporting this view are facts about natural language that only come into focus once we examine it in a more meticulous and less superficial fashion. Despite their apparent differences, all human languages share fundamental and non-trivial structural properties (Chomsky, 1986). These *linguistic universals* are common to all human languages. I have already mentioned some of them in prior sections: (1) sentences are built out of phrases that are organized in a tree-like structure and never according to a linear organization; (2) the C-command constraint on pronoun and anaphora reference is also found in all human languages. Moreover, we also find linguistic universals in an area where arbitrariness and conventionality is obvious: sound-meaning pairings. Indeed, there are strict constraints on the kinds of sounds that can be used for linguistic purposes. All human languages draw from the same limited set of sounds. These are only some of the many examples of fundamental structural similarities shared by human languages.

If ontological externalists were correct and the principles governing languages were indeed arbitrarily chosen conventions, it is odd that we find linguistic universals like those just mentioned. The probability would seem quite high that at least one community would have adopted a serial sentence organization or a different constraint for pronoun and anaphora reference. The existence of universal features in human languages becomes even more puzzling considering their highly complex and hierarchical nature. One would be hard pressed to provide a convincing account of how a pre-linguistic or a primitively linguistic community came to elaborate and agree upon (implicitly or explicitly) the C-command constraint. As pointed out in our discussion of language acquisition, most linguistic principles are neither simple nor obvious in any pre-theoretical sense. Despite their inherent complexity, all linguistic communities are supposed to have generated these same linguistic principles.

Unless ontological externalists can provide a satisfactory explanation of linguistic universals, the view that language is governed by arbitrary conventions is hopeless. Some (Putnam, 1979b) believe that they have an answer to this objection. If we assume that all human languages can be traced back to a single primitive language, this could explain why languages today share some striking similarities, especially with respect to fundamental structural properties. Because structural properties are likely to be elaborated first, they became deeply entrenched. They constitute the matrix out of which all other languages have evolved. The first speakers agreed upon a set of specific principles, but they could have chosen others. It is a contingent fact of human history that those principles, which we now consider to be linguistic universals, have been selected initially. If we accept this story about the evolution of human languages, we can still maintain that linguistic principles are arbitrary conventions.

Two important problems make this response extremely weak. First, it does not explain how our common linguistic ancestors generated and agreed upon complex linguistic principles like the C-command constraint. That they did is 'explained' by serendipity. It is impossible to entirely exclude this possibility, but an appeal to luck is a highly unsatisfactory explanation. If another one is available that does not rely on serendipity, it should be preferred. A truly conclusive objection to the historical explanation of linguistic universals, though, comes from the study of Creoles. As we saw in Part 1, Creoles develop out of pidgins, which lack most distinctive structural features of natural language. As a result, the development of Creoles has been argued to offer a glimpse of the origin of natural language (Bickerton, 1999). Because Creoles are new languages that lack the kind of historical lineage characteristic of non-Creole languages, they provide a good test case for the historical explanation. If it is because contemporary languages have developed from a common ancestor that they share similar fundamental structural properties, then some Creoles should exhibit different structural properties because they have distinct historical lineage. Yet, this is not the case. All Creoles analyzed exhibit the linguistic universals found in non-Creole languages. In fact, Creoles, wherever and whenever they appear, share very similar grammatical properties (Bickerton, 1999).[131] These observations undermine ontological externalists' historical hypothesis and leavesthem with serendipity to explain linguistic universals. We will see below that a much better explanation for the existence of linguistic universals is available once we look beyond the empiricist account of language acquisition.

Ontological externalists also believe that their position is supported by evidence from diachronic changes of human languages. Despite their claims, the

[131] Three features that creoles share are "lack of the use of tone, particularly to contrast monosyllables; very little or no inflectional morphology; and semantically transparent (highly regular and predictable) derivational morphology". (Finney, 2004)

study of language transformations in time does not indicate that evolution is always gradual and that it operates in a piecemeal fashion (Lightfoot, 1984 and 1999). In fact, there are strict limits on what kinds of grammatical transformations can take place. To quote Lightfoot (1999, 95): “We do not find complex arrays of linguistic data changing randomly. Instead, they tend to converge toward a relatively small number of patterns or attractors […]”. If we consider the case of syntax, diachronic evolution is best described in terms of ‘punctuated equilibrium’ (Lightfoot, 1999). The set of ‘equilibrium points’ is not infinite; there is a restricted set of stable configurations that a language can evolve towards. These are Lightfoot’s ‘attractors’. Equilibrium configurations all meet fundamental constraints that can be captured in a theory of what Chomsky calls *Universal Grammar*. Lightfoot also observes a peculiar feature of the diachronic evolution of human languages. Periods where little transformation takes place are followed by short periods where ‘catastrophic’ transformations occur that have wide-ranging effects. More often than not, transformations have an effect on a cluster of grammatical features that appear unrelated, at least on a superficial level. If diachronic changes are driven entirely by human choices, it is difficult to understand how a transformation affecting the linguistic principle P correlates with a modification of linguistic principle T when these principles share no obvious connection from the layperson’s standpoint. But if we hypothesize that diachronic changes are constrained by universal factors and that the principles governing human languages can only vary along strictly defined paths, then these observations are less puzzling (see, Lightfoot, 1999).

If the arguments offered in the last few pages are correct, ontological externalism is not a sound understanding of the ontological nature of language. Despite its commonsense appeal, the *form of life* or *institution* paradigm must be rejected in favor of a new ontological account of language. In Part 3, I describe a different ontological approach to language. Instead of being a social and historical artifact, I argue that language is, to quote Chomsky, an *organ*.

4 Epistemic externalism

Ontological externalism is a hypothesis about the ontological nature of language. It specifies what kind of entity language is. Epistemic externalism is a hypothesis about the nature of *linguistic competence*. It is a theory about language possession. This issue is often formulated in terms of 'knowledge' (e.g., Chomsky, 1986; Dummett, 1996b). In common parlance, we say that a competent speaker of English 'knows English'. What epistemic externalism tries to describe is what kind of knowledge is linguistic competence.

Philosophers distinguish between different types of knowledge. For our purpose, the crucial distinction is between what is usually referred to as know-how and know-that. Know-that, or propositional knowledge, is the kind of knowledge that can be fully captured and made entirely explicit by a proposition.[132] For example, I know that the capital of Albania is Tirana. This piece of knowledge I possess is exhausted by the proposition "The capital of Albania is Tirana". What I know is this proposition. Know-how is the kind of knowledge associated with skills and ability. Bike riding is often offered as an

[132] Discussion of knowledge always leads to the issue of justification. For my purpose, I do not need to tackle this thorny problem. I will simply assume that we do have genuine knowledge that can be of one of two kinds, namely know-that and know-how.

instance of know-how. My knowledge of bike riding is not reducible to the knowledge of a set of propositions. Instead, it is a capacity that I possess that is procedural rather than propositional. While it is possible to offer a propositional description of what is involved in bike riding (e.g., keep your balance, pedal, steer, etc.), these statements seem to leave out a crucial component of the bike riding ability. Indeed, if knowledge of these propositions were sufficient to know how to ride a bike, none of us would need to go through the painful trial and error process associated with learning how to ride a bike. We would simply have someone provide us a descriptive explanation of bike riding and we would be good to go. Furthermore, one does not need knowledge of the propositions describing the 'bike riding skill' in order to possess it. Most of us are unable to offer a comprehensive propositional description that even comes close to capture what knowing to ride a bike or even walking involves. We simply know how to do these things. We have mastered these skills and possess these abilities.

With respect of linguistic knowledge, the question is whether it is know-how or know-that. Is knowledge of English best described as the possession of a specific skill (or set of skills) or the possession of some propositional knowledge? Epistemic externalism is the view that knowledge of language is a kind of know-how. To know a language is to possess a particular ability. This view is best described as a kind of 'externalism' because knowledge is indistinguishable from the skill, whose possession is indistinguishable of its external realization. Notice that this view flows quite naturally (but not necessarily) from the idea that language is a social institution and a collective practice. If language is an institutionalized practice, it makes sense to describe language possession as a skill, namely the skill that enables someone to take part in a certain social practice.

Wittgenstein (2000) expounds the idea that language is know-how and not know-that. According to Wittgenstein, the knowledge of language is knowledge of how linguistic expressions are correctly used. Put differently, knowledge of language is knowing how to play the multitude of language games that constitutes a language. Here again, it is worth focusing on the analogy Wittgenstein draws between using language and playing a game. Wittgenstein points out (2000, paragraph 31) that there are many ways one can learn how to play a game. Using the example of chess, he imagines that someone could learn the game by studying a document listing the moves allowed. For this person, the knowledge of chess playing would be best described as know-that because the knowledge is fully captured by propositions. In the *Investigations*, Wittgenstein can be seen fighting the assumption that linguistic knowledge is always acquired in this way (i.e., by means of internalizing propositions) and that it necessarily constitutes propositional knowledge. This assumption is wrong for language but also chess playing. Indeed, Wittgenstein points out that it is entirely possible for someone to learn how to play chess by watching other people play and 'without ever learning or formulating rules' (2000, paragraph 31). By watching, the learner acquires know-how but not know-that. The fact that the chess player's know-how can be captured by propositions does not entail that she has knowledge of these. In other words, we would be wrong to ascribe this propositional knowledge to her since her chess playing is really an ability that does not require the internalization of propositions. For Wittgenstein, this second scenario best describes how we learn to play the vast majority of language games. Knowledge of language is overwhelmingly the mastery of skills, not the possession of propositional knowledge. It is in this sense that Wittgenstein (2000, paragraph 199) writes that '[T]o understand a language means to be a master of a technique'.[133]

Wittgenstein's claim that linguistic knowledge is know-how has had a tremendous influence on the development of analytic philosophy of language. Ordinary language philosophers like Ryle defend a similar view. In fact, they are probably even more radical than Wittgenstein, who seems to recognize that some components of linguistic knowledge can possibly be propositional in nature. Ordinary language philosophers, who were mostly proponents of analytical behaviorism, reduce linguistic competence to behavioral dispositions. Dummett is also working within the Wittgensteinian tradition, but eschews the crude behaviorism of ordinary language philosophers. For Dummett, linguistic competence is the practical ability to 'recognize the truth conditions of sentences has and when they obtain' (Gunson, 1998, 27). Notice that the practical knowledge is the 'ability to recognize' and not the ability to state the truth conditions of a statement. It is obvious for Dummett that we do not possess explicit knowledge of truth conditions, but only an implicit one, which is expressed by the ability to recognize correctly truth conditions. We do not have a propositional knowledge of truth conditions for statements that we produce or interpret. Dummett sees it as the task of philosophy of language to produce a theory of meaning which provides a description, one that is couched in the

[133] In paragraph 150, Wittgenstein (2000) makes the same point: "The grammar of the word "knows" is evidently closely related to that of "can", "is able to". But also closely related to that of "understand". ('Mastery' of a technique.)"

language of intentions and reasons, of the ability to 'recognize truth conditions and when they obtain' for statements of a language.

Quine's repugnance towards mentalism has already been discussed at length. This motivates his rejection of intensional notions like meaning, and explains why he is an adamant ontological externalist about language. The same anti-mentalist attitude prompts him to defend epistemic externalism. For Quine, language is a 'social art'. Someone has successfully mastered the social art of language if she is disposed to assent and dissent like other members of her speech community. Just like many ordinary language philosophers, Quine adopts the behaviorist framework. Linguistic knowledge is reduced to a kind of conditioning that results from rewards and punishments doled out by members of the speech community during language acquisition period. The knowledge acquired is not propositional, but strictly procedural. To quote Quine, what the speaker has internalized is a 'complex of present dispositions to verbal behavior' (in Chomsky, 1986, 31). It cannot be otherwise given Quine's rejection of meaning and synonymy. If knowledge of language is a kind of propositional knowledge, then semantic knowledge would be propositional. To know the meaning of a linguistic expression would be to have internalized a statement of the form 'X means ABC' where ABC is a proposition built out of concepts. Thus, ABC is synonymous to X. But Quine thinks that the notion of semantic synonymy (but not stimulus synonymy) is incoherent. Hence, semantic knowledge cannot be propositional knowledge.

Since 'A Nice Derangement of Epitaphs' (1986) and onwards, Davidson's philosophy has been undergoing a significant transformation. As pointed out above, he comes to question the very existence of languages as commonly understood and the idea that a language can be fully captured in a theory consisting of T-sentences and recursive rules in favor of language *qua* interpretative capacity. In a recent article (1997, xvi), Davidson states this explicitly when he writes that:

> [Language] is not a material entity of any sort; it is an attribute, a skill, or ability each of us has for coping with others. It is a human organ, the organ of propositional perception.

What Davidson has in mind here is not entirely clear. Richard Rorty (1998) takes such a statement as indicating that Davidson is moving squarely into the camp of Wittgenstein in describing linguistic knowledge as a kind of know-how. However, elements found in 'A Nice Derangement of Epitaphs' (1986) and in other recent articles by Davidson (e.g., 1997) conflict with Rorty's interpretation. Indeed, Davidson introduces the notions of prior and passing theories, and these seem to be essentially propositional in nature. Furthermore, he stresses that true mastery of a linguistic expression cannot be reduced to a disposition for using it only in the right situations, but it involves also the possession of a certain amount of propositional knowledge. To quote Davidson:

> Even a simple sentence like 'That's a spoon' (perhaps boiled down to 'Spoon!') if understood requires knowledge of what spoons are for, that they are persistent physical objects, and so on. So there must be more to content than is conveyed by saying it is given by the situation that stir us to accept or reject sentences appropriate to the situations. (1997, 24)

Davidson's position on linguistic knowledge seems to be a hybrid of know-how and certain kinds of know-that.[134]

[134] There are many other philosophers who defend the view that linguistic competence, especially semantic competence, is know-how. Putnam writes "knowing the meaning of the word 'gold' or

4.1 Arguments for epistemic externalism

A number of considerations are offered in support of epistemic externalism. The mastery of language reveals itself in the behaviors of the fluent speaker e.g., she is able to successfully communicate with other members of the speech community.) From a pre-theoretical perspective, linguistic competence is equated to a kind of behavioral competence. A necessary, but not sufficient, condition for being know-how is being a behavioral or procedural competence. Non-behavioral and non-procedural competences (e.g., knowledge of the atomic number associated to each chemical element in the periodic table) do not meet the essential criterion for being know-how. In addition to fulfilling this initial condition, linguistic knowledge exhibits another hallmark feature associated with know-how. When asked to describe what their linguistic knowledge amounts to, the vast majority of fluent speakers are completely at a loss. They are unable to provide a list of propositions that captures their linguistic knowledge. Their predicament is identical to the one we find ourselves in when asked to explain our knowledge of bike riding or walking. We do not face similar difficulties when we are prompted to express knowledge that is propositional. Take the knowledge of the name of the capitals of Canadian provinces. If someone possesses this knowledge, then, *ceteris paribus*, she can list the capitals of all Canadian provinces. There are various reasons why she might not *want to* (e.g., she does not feel like talking, etc.) or *could not* (e.g., aphonia due to a throat ailment) produce this knowledge, but these difficulties are not caused by the propositional

---

the word ‘elm’ is not a matter of knowing that at all, but a matter of knowing how”. Michael Devitt claims that knowledge of meanings is ‘an ability or a skill: a piece of knowledge-how not knowledge-that.’ (All quotes from Stanley & Williamson, 2001, 411) nature of the knowledge itself. Thus, if linguistic knowledge was propositional knowledge, then, *ceteris paribus*, we should be able to externalize verbally.[135] Since we cannot, it is most likely a form of know-how.

Another option would be for linguistic knowledge to be tacit or unconscious propositional knowledge. The difficulty we face in verbalizing our linguistic knowledge would not be due to the fact that it is not propositional, but simply because it is beyond the reach of our conscious grasp. There is a long tradition of skepticism among philosophers about tacit propositional knowledge. Descartes argued against unconscious knowledge based on the necessary transparency of the mind to itself. If the mind is the locus of all thinking, then it is contradictory to hold that it can generate thoughts and fail to be conscious of them. More recently, Sartre (1943) holds a similar position that leads him, among other things, to reject the Freudian notion of the unconscious.

Influential philosophers who are part of the analytic tradition and who reject tacit propositional knowledge usually do so for reasons germane to those examined in the discussion of rule-following. Here again, I want to focus on Searle's argument. The first premise of his argument is unproblematic: knowledge is a kind of mental state.[136] Searle recognizes the existence of

[135] After having written this passage, I came across a discussion of this issue by Bechtel and Abrahamsen (quoted in Stanley & Williamson, 2004, 439) that is strikingly similar to my own: "A person who *knows that* Sacramento is the capital of California will be able to retrieve from memory the proposition Sacramento is the capital of California, or to retrieve other propositions from which this one can be deduced. But the same does not seem to hold for *knowing how* to ride a bicycle. In this example, what is required is to have a certain ability to control one's motor perceptual-motor system".

[136] Searle rejects the view that computers can follow rules or have knowledge. Intentionality, rule-following and knowledge are unique humans because of their particular biological structure. This is Searle's doctrine of *biological naturalism*. It should not be confused with the kind of biological naturalism advocated by those working within the rationalist tradition.

unconscious mental states. However, an unconscious state can be *mental* if and only if it is 'the kind of thing that could be a conscious mental state'. Keeping this requirement in mind, let's consider tacit linguistic knowledge as posited by biological rationalists. According to one interpretation, the speaker has unconscious knowledge of abstract computational algorithms (i.e., a grammar), and the computation happens unconsciously. The problem for Searle is that if it is impossible for the speaker to become consciously aware via introspection that she realizes and operates a specific grammar, the grammar is not a mental object and the possession of grammar a mental state.[137] A fortiori, the possession of grammar cannot be a kind of knowledge since knowledge is, by definition, a mental state.

Given the putative difficulties surrounding the notion of unconscious propositional knowledge and the fact that linguistic competence fails to exhibit the properties of propositional knowledge *simpliciter*, the hypothesis that knowledge of language is know-how gains additional support. Another benefit of defining linguistic competence in terms of know-how for epistemic externalists is it does not require positing underlying cognitive states and processes. Linguistic competence can be accounted for strictly in terms of directly observable features. For philosophers like Quine, avoiding mentalism is a basic requirement of a truly naturalistic account of knowledge of language. The idea that a theory of linguistic competence should be divorced from neuropsychological considerations is deeply engrained in analytic philosophy (Wittgenstein, 2000; Dummett, 1996b; Soames,

[137] Searle is quite clear on this issue. In order to count as mental, the very state that is unconscious must have the necessary properties to become conscious. According to Searle (2004, 249), "[A]n unconscious mental state, when unconscious, consists in a capacity of the brain to produce that state in a conscious form and to produce behavior appropriate to that state".

1984). How linguistic knowledge is realized at the neuropsychological level is supposed to be irrelevant to questions of philosophy of language. Someone knows a language if she can successfully communicate with members of the community using this language. In other words, they share rule-following behaviors or dispositions, and not necessarily the same neurological and cognitive structures. If the former condition is met, then this is sufficient to grant linguistic competence. Quine makes this point using a metaphor:

> Different persons growing up in the same language are like different bushes trimmed and trained to take the shape of identical elephants. The anatomical details of twigs and branches will fulfill the elephantine form differently from bush to bush, but the overall outward results are alike (1960, 8).

Finally, considerations pertaining to semantics are believed to favor epistemic externalism. If one is convinced by Quine's reasoning against intensional notions like meaning and synonymy, one way to cash out semantic competence is in terms of know-how; for Quine, the know-how amounts to dispositions to assent and dissent. While he does not adopt Quine's meaning eliminativism, Wittgenstein thinks that semantic competence is best described as a kind of know-how. The slogan 'meaning is use' puts the emphasis on the fact that the meaning of linguistic expressions cannot be captured (in most cases) by propositional statements. The multiplicity of uses that linguistic expressions allow is taken as a conclusive demonstration of this. Semantic competence is the possession of a skill that enables us to use linguistic expressions appropriately in situations we encounter. Some might see a tension between what I have just said and the connection Wittgenstein draws between language and rule-following. If linguistic competence involves rule-following, why not think that linguistic knowledge is reducible to the propositional knowledge of the rules governing use? The tension is resolved when we understand that, for Wittgenstein, rules never fully exhaust the possible uses of linguistic expressions. Rules delineate more or less roughly the potential uses of words, but there remains a space for creativity (Wittgenstein, 2000, paragraphs 80-85; Seymour, 2005, 91). For Wittgenstein, linguistic competence is the ability to apply rules to new situations and to transcend rules when required (2000, paragraph 83). This ability cannot be defined by rules that can be stated propositionally. In the same way that we cannot describe propositionally the relation of family resemblance but can still identify such a resemblance, linguistic competence is not reducible to a set of propositional rules that are mechanically applied; it is a know-how.

4.2 The problems of epistemic externalism

Whether someone possesses a given ability is assessed based on her behaviors. Someone has the ability to ride a bike if she can hop on a bike and ride it in the proper fashion. In other words, being capable of producing certain behaviors constitute the *criterion* for the possession of knowledge-how. If linguistic competence is indeed a kind of know-how, it follows that the criterion for the possession of linguistic knowledge must also be the capacity to produce specific behaviors. In the case of language, successful linguistic interaction with members of the language community is the criterion of knowledge possession.

Chomsky points out in numerous places (1986, 2000) that taking behaviors (or what he calls *performance*) as criteria for linguistic competence is untenable. Consider the following case. John suffers from a terrible disease that deprives him from his capacity to move and interact with other human beings. The disease does not affect neurological capacities; this is demonstrated by various tests (i.e., there is no difference in brain scans before or after the onset of the disease, ECG is identical, etc.). Based on this, it seems legitimate to conclude that Jones' cognitive faculties, which supervene on his neurological structures, remain unchanged.[138] If the criterion for the possession of linguistic knowledge is exhibiting the right kind of linguistic behaviors, then we should conclude that John has lost all his linguistic knowledge. But this seems extremely implausible given that everything in John's brain activity (at least everything that does not pertain to the motor systems) remains unchanged. Imagine that a cure to John's illness is found, and he can once again engage in linguistic interactions with members of his speech community. If epistemic externalism is correct, we should conclude that John has learned anew the linguistic knowledge he had lost when he was impaired. This explanation is completely unreasonable. Much more likely is that John momentarily lost the capacity to express his linguistic knowledge due to his physical impairment and regained it once cured. His linguistic knowledge remained constant throughout the whole episode; it is his capacity to externalize this knowledge that fluctuated.

Another example inspired by Chomsky can be used to reinforce the previous point. Jenny is a pathologically shy person. When in public, she has a hard time speaking properly. She stutters and most of her utterances end up being barely comprehensible. As a result, she avoids meeting people out of fear of

[138] For reasons mentioned earlier, I do not consider dualism to be a viable option. Thus, I do not take it into account here.

having to talk to them. She spends most of her days alone reading in the library. One day, she decides to do something about her extreme shyness. She takes public speaking classes and meets with a psychologist to overcome her shyness. Her therapy proves very successful; she can now talk in public with ease. If we accept the idea that ability and linguistic knowledge are necessarily correlated, then we should conclude that Jenny's linguistic knowledge has increased as a result of taking public speaking classes and undergoing psychotherapy. But this cannot be correct. The correct explanation is that Jenny's knowledge of English has remained essentially stable, but her ability to talk in public improved dramatically. The problem was not her poor mastery of the English grammar, but her pathological shyness.

Based on these examples, we can conclude that we should not use behavior as a criterion for the possession of linguistic knowledge. This is not to say that behavioral data do not play the role of evidence when assessing linguistic knowledge. They clearly do, but it is not criterial. In fact, one can argue that exhibiting certain behavioral patterns is itself never entirely sufficient to decide whether linguistic knowledge is present. The following science-fiction scenario should make this clear. Jones has been abducted by an alien life form from Mars. Using a special laser beam, the aliens have fried Jones' brain and turned him in a zombie. The aliens control Jones' actions using some sophisticated technology. Because the aliens do not want the authorities to discover that Jones has been abducted, they make sure that he continues to act as he did before. For one thing, Jones goes on speaking English (i.e., behaving like an average English speaker). If behavior is the criterion for linguistic knowledge, we must conclude that Jones knows English. But given the brain damage Jones suffered, this is physically impossible.

Not everyone agrees that we cannot distinguish between possession of know-how and its instantiation. Consider the case of John, who is tied to a chair. John is healthy and can normally walk. At the moment, he cannot walk because of his situation. Epistemic externalists argue that they are not committed to the absurd conclusion that John does not know how to walk anymore. Instead, they say that he is not in a situation where he can realize his know-how. Certain conditions are needed for know-how to be realizable. But this is not exceptional; it is a feature of all dispositions. All things being equal, glass is disposed to break if smashed with a hammer. The fact that in some situations glass does not shatter when hit with a hammer (e.g., the hammer is made of rubber, etc.) does not justify the conclusion that glass is not breakable. We can elaborate a similar story when it comes to knowledge of language and its outward realization.

This argument does not hold water. In fact, it plays right in the hands of those who argue that linguistic knowledge should be understood internally (Chomsky, 1986). But let's try to determine what exactly linguistic knowledge *qua* disposition is independently of its behavioral realization. In the case of the glass, its disposition to break is reducible to the molecular properties of the material. It is because of its intrinsic properties that glass is prone to breakage in certain conditions and not others. In the case of language, we are forced also to turn to internalist considerations. It is because of some internal property that someone can talk in certain situations and not others. The nature of the internal property involved here remains unspecified and epistemic externalists owe us an account. To simply say that this is a second-degree know-how begs the question and is entirely unhelpful.

The moral that must be drawn form this discussion is that when seeking to account for linguistic knowledge, it is crucial to distinguish *competence* and *performance*. Competence is what the speaker knows and is not know-how in the traditional sense. Performance subsumes the linguistic behaviors produced by the speakers. It is never criterial when it comes to the possession of linguistic knowledge. Furthermore, performance does not necessarily tell us about the complete scope of the speaker's knowledge. At most, performance is one kind of evidence out of many that can be used in the attempt to elaborate a sound theory of language.

From the fact that knowledge of language is not know-how, we should not conclude that it is a form of know-that. As will be argued below, we must go beyond the know-how/know-that dichotomy if we are to understand linguistic competence.

5 Semantic externalism

Semantic externalism is the fourth and last component of the externalist doctrine. It is the one that has generated the most passionate discussion amongst philosophers. The central claim of semantic externalism is that subject-external properties (i.e., properties 'outside the head') individuate meaning. Defined negatively, semantic externalism is the view that we cannot provide a complete account of linguistic meaning in terms of the speaker's internal properties. To borrow Segal's terminology (2000), meaning is not 'locally supervening' but 'environmentally supervening'. It follows from this claim that meaning possession involves a specific relationship between the subject and subject-external properties.

There are different ways to cash out semantic externalism's core tenets. Philosophers disagree about which subject-external properties individuate meanings. They also quarrel about the nature of the relationship that connects the speaker and subject-external properties. In what follows, I want to examine, if only in a cursory fashion, some of the attempts to flesh out the basic semantic externalism framework. I have chosen the theories that are the most widely discussed in the literature right now. In the end, I want to argue that none is satisfactory because they all rely on the same mistaken premise, namely that meaning is individuated on the basis of subject-external properties.

5.1 Varieties of semantic externalism

5.1.1 Direct reference semantics

Revived by the seminal work of Kripke (1980) and Putnam (1994), the direct reference hypothesis has been the focus of an extremely active research program (e.g., Recanati, 1993; Salmon, 1998). According to this position, the referent determines the meaning for many types of linguistic expressions (proper names, natural kind terms, etc.) For example, the meaning of the name "Stephen Harper" is Stephen Harper himself, and not something else such as a description (e.g., the current prime minister of Canada and the leader of the right-wing Conservative Party, etc.) or a private mental state (e.g., my private representation of Stephen Harper). While direct reference works well with proper names, it appears less suited for other kinds of linguistic expressions like personal and demonstrative pronouns, names of fictional characters and logical connectives. Proponents of the most radical form of the direct reference hypothesis (e.g., Kaplan, 1975; Salmon, 1986) believe that the meaning of these linguistic expressions is based on reference alone. Some defend a less extreme version of the direct reference theory. Putnam (1994), for example, argues that the referent is central to the meaning of certain kinds of linguistic expressions (e.g., natural kind terms), but he recognizes that other elements contribute too (e.g., semantic marker, syntactic marker and stereotype.)

We can distinguish three kinds of direct reference theories based on the kind of relationship that is claimed to hold between the speaker and the meaning constituting referent. Kripke (1980) and Putnam (1994) defend a causal-historical account. For Jones to know the meaning of "Stephen Harper" is to stand in a specific causal and historical relationship to the individual Stephen Harper. Kripke imagines that we get assigned our name in an event that could be described as an 'initial baptism ceremony'. The parents of Stephen Harper named their child "Stephen Harper"; this is an historical event—it took place at a certain time in history—and a causal event—the baptism is a specific kind of causal occurrence (e.g., a pointing gesture followed by the utterance of certain words). From then on, the name "Stephen Harper" is associated to a specific individual. Whenever someone uses this name, they are in fact taking part in a causal chain that goes back to the initial baptism ceremony. What causes me to utter "Stephen Harper" (and not other words) when I want to talk about Stephen Harper is ultimately Stephen Harper's parents' initial use of "Stephen Harper" to refer to their son. Stephen Harper's parents' initial utterance caused other people to use the same words to refer to their son. At one point in time, I became connected to this causal chain. Because my use of the name "Stephen Harper" reaches back to the individual himself via a causal chain leading to the initial baptism, I speak *about* Stephen Harper when I utter this name. In short, "Stephen Harper" means Stephen Harper. Despite the fact that I do not know Stephen Harper personally, I can still talk about him because I am causally connected to him if only remotely.

Informational semantics offers a different account of the relationship between speaker and referent. Reference is defined as a nomic relation between world and mind (Dretske, 1981, Fodor, 1998). A linguistic expression refers to and means that which reliably causes it to be tokened. So, "dog" means [dog] because dogs (or doghood) reliably cause the tokening of "dog". That some entities rather than others cause the tokening of an expression is a function of the referent's and speaker's causal properties. One way to illustrate informational semantics is by means of an analogy with an *indicator*. The tokening of the word "dog" *indicates* the presence of the property doghood in the environment. Meaning possession amounts to being a reliable indicator.

Teleological semantics (Millikan, 2004) is a modification of the informational semantics framework. From informational semantics, teleological semantics borrows the idea that meaning possession is to be an indicator of certain subject-external properties. However, it introduces an evolutionary element in the framework. An expression E means M because its evolutionary function is to indicate those things that are M in the environment. Thus, a linguistic expression refers to what it was *selected* to indicate, and its meaning is determined by what it refers to.

5.1.2 Assertibility condition semantics

Defended by the likes of Dummett and Wittgenstein[139], assertibility condition semantics is the claim that the meaning of a linguistic expression is determined by the circumstances for its appropriate use. The basic unit of analysis within this framework is the sentence; individual words do not have assertibility conditions. The utterance "dog" is not a legitimate speech act and it is meaningless to talk of assertibility conditions in this context. However, the utterance "This is a dog!" is a speech act that can be used appropriately only, or so it is argued, when certain environmental circumstances obtain, namely when there is a dog in the speaker's vicinity. Thus, the meaning of "This is a dog!" is the set of environmental circumstances for its appropriate use. Physical properties are not the only relevant properties that determine assertibility conditions. Social and historical properties also play a crucial role like Putnam (1994) and Burge (1979).

Someone knows the meaning of a sentence if she knows how to use it appropriately. This means that the speaker must have internalized the conditions that warrant its use. For proponents of assertibility condition semantics, knowledge of the conditions of appropriate use is a know-how. What a competent speaker possesses is the ability to recognize those circumstances that allow for the appropriate use of a sentence. Some ground this ability in some kind of analogical faculty (Quine), while others in a more obscure capacity of 'knowing how to go on' in the application of a rule (Wittgenstein, Kripke).

[139] This is a controversial claim defended by some commentators like Dummett, Kripke, Peacock and Seymour. See Seymour (2005) for a discussion of this issue.

5.1.3 Truth-conditional semantics

Whereas assertibility condition semantics contends that the meaning of a sentence is captured by conditions of appropriate use, truth-conditional semantics holds that it is the conditions that make a sentence true that determine its meaning. Davidson argues that a theory that specifies the truth-conditions of linguistic expressions does what we expect from a theory of meaning. Indeed, if one knows what conditions must obtain for the sentence “Robert Tremblay owns a John Deere lawnmower” to be true –namely that Robert Tremblay possesses a lawnmower of the John Deere brand—then she knows the meaning of the sentence. In this framework, meaning is a referential relationship between sentences and states of affairs (Lycan, 1999). Quoting Lycan (1999, 136), truth-conditional semantics “is [back] in the business of mirroring nature, of asking what actual or possible states of affairs does a given target sentence depict or represent”.

Because natural language can be used to generate an infinite number of sentences, semantic knowledge cannot take the form of an exhaustive list stating the truth-conditions for every possible sentence.[140] Rather, semantic knowledge is the capacity to retrieve the truth-conditions of sentences based on their constituents and syntactic structure. Sub-sentential constituents have truth-conditions (e.g., the reference set of “dog” is dogs) and syntactic structure determine how the constituents relate to each other; these two factors determine the truth-conditions. Since a language has a finite number of sub-sentential

[140] In technical terms, to know a language cannot amount to having in memory the T-sentence for each sentence.

constituents and rules of syntax, it is possible for the speaker to acquire them (Davidson, 1984).

5.2 Arguments for semantic externalism

One crucial reason why semantic externalism is so popular is that it captures and provides a theoretical framework to understand some commonsense intuitions about the relationship between language and the world. Consider the sentence “My dog is sleeping under my desk”. Spontaneously, we say that the sentence is about that dog which is mine and which is found under the table that is also mine. In more technical terms, we take the sentence to *represent* a certain state of affairs, namely the fact that my dog is sleeping under my desk. Intuitively, it seems accurate to think that the meaning of the sentence is specified by the state of affairs it represents.

The idea that language is *intentional* (i.e., characterized by *aboutness*) is the received view in philosophy. Many take the task of making explicit what intentionality is and how it is possible to be the central problem of philosophy of mind and language. A position that could elucidate how language is intentional will have much going for it. For many, semantic externalism seems to give us the means to make sense of intentionality because it ties meaning to the world. The different versions of semantic externalism discussed above vary in how they cash out intentionality. Direct reference semantics offers a causal account of *aboutness*. Proponents of truth-conditional semantics defend a representational hypothesis of *aboutness*. Assertibility conditions semantics explains intentionality in terms of discursive practices (Brandom, 1994).

Semantic externalism finds additional support in a series of thought experiments (i.e., Putnam (1994, 1992) and Burge (1979)) that are supposed to demonstrate that meaning must be individuated externally on pain of counter-intuitive consequences. The Twin-Earth thought experiment developed by Putnam is said to prove that meanings cannot be individuated simply on the basis of subject-internal properties but depend crucially on physical properties of the speaker's environment for their individuation. This is especially clear in the case of natural kind terms. Putnam asks us to imagine that there is a planet, called Twin Earth, that is exactly like Earth in almost all its features. The identity holds for people inhabiting the planet (i.e., each of us has a doppelganger on Twin Earth), the language spoken (i.e., some speak English, some French, other German, etc. on Twin Earth), the chemical composition of about everything (i.e., gold has the atomic number 79 on Twin Earth, the composition of salt is NaCl, etc.), and so on. In fact, there is only one small difference between Earth and Twin Earth: the chemical composition of the stuff that has all the macrolevel properties of water (e.g., found in river, thirst-quenching, tasteless, etc.) is XYZ instead of H_2O. In short, wherever you find H_2O on Earth, you find XYZ on Twin Earth.

According to Putnam, this scenario allows us to see the role played by environmental properties in the individuation of meanings. On both planets, speakers have the word "water" in their lexicon. Given that H_2O and XYZ have identical properties except for their respective microstructure, we assume that speakers on both planets share the same internal representation of both substances. If the meaning of the term "water" is the internal representation that speakers have of the substances, then we must conclude that "water" has the same meaning in English and Twin-English. But this is wrong, according to Putnam. The word "water" on Earth refers to a different substance than its counterpart on Twin-Earth, and this is sufficient to distinguish the meaning of "water" in English from its meaning in Twin-English. The fact that inhabitants of Earth and Twin Earth are oblivious to these differences (i.e., imagine the thought experiment takes place in 1750 before the composition of water on Earth was discovered) is irrelevant for Putnam. Even if no one knew of the difference in reference, 'they would have had, Putnam argues, a different meaning' (1992, 32). Someone from Earth who would fly to Twin Earth would commit a mistake in using the English word "water" to talk about the stuff found on Twin Earth.

Unless we are ready to accept that "water" and Twin-"water" have the same meaning—a position that seems to conflict with some commonsense intuitions we have about the relationship between meaning and reference—, then we must conclude that subject-external properties, in this case chemical composition, contribute crucially to semantic individuation. Thus, the Twin-Earth argument supports semantic externalism.

A different set of thought experiments is offered to show that social factors, which are equally subject external, contribute to meaning individuation. Tyler Burge's argument that I considered earlier is supposed to establish that there is a connection between the meaning of linguistic expressions and community usage. Putnam reaches a similar conclusion by following a different route. He claims that in many cases reference, and therefore meaning, is set by a sub-group of the linguistic community that possesses particular technical expertise. Putnam defends this claim by considering the meanings associated to “elm” and “beech”. He contends that most English speakers are unable to distinguish elms from beeches reliably. The layperson’s knowledge about these two species is insufficient to tell them apart. For most, the stereotype of an elm is identical to the stereotype of a beech. As a result, the internally individuated mental representations (i.e., the stereotypes) associated to the words “elm” and “beech” are identical for non-experts. Yet, few would argue that “elm” and “beech” have the same meaning. Elms are not beeches (i.e., different genetic make-up, etc.) and people do not mean “elm” when they use “beech” and vice versa even if they cannot tell apart elms from beeches. But how can the layperson be said to associate different meanings to “elm” and “beech” if the mental representations associated to these words are identical? According to Putnam, the semantic difference cannot be explained in terms of difference of mental representations, but it is the consequence of a certain kind of social relationship. The layperson usually looks to experts to settle the semantics of these terms. Since experts recognize that the extension of “elm” and “beech” differ, which means consequently that their meaning must be different also—this is conclusion of Twin Earth thought experiment—, the layperson who defers to experts for the semantics of these terms also associates different meanings to them. It is true that between the layperson and the experts there is a clear difference in the amount of *knowledge* about elms and beeches. However, there is none with respect to mastery of the meaning of each term, at least according to Putnam. Now, if the layperson relies on experts to settle reference, then experts contribute to semantic individuation. The meaning of “elm” and “beech” are not individuated on the basis of internal properties of mental representations (allegedly the same in both cases) but by the opinion of experts, which is a subject-external property.

The last consideration supporting semantic externalism is one that we have encountered already. A majority of philosophers believe that *publicity* of meaning is ‘non-negotiable’, to borrow Fodor’s expression (1998). For Frege and Dummett, meanings need to be public if we want to guarantee successful communication and avoid skepticism. Others, like Fodor (1998), think concepts and, by extension, meanings must be public in order to make sense of the robustness of intentional explanations and to validate a psychology based on intentional explanations. If intentional explanations are successful, it must be because they describe our cognitive processes accurately; our cognitive processes *must be*, Fodor contends, operations over beliefs, desires, etc. A psychological science that relies on intentional explanations is a meaningful enterprise only if we can assume that its generalizations (e.g., If X desires Y and X has the means to get Y and X has no reasons not to want her desire to be fulfilled, then X will get Y.) are true, *ceteris paribus*, for all members of the human species. But this can be the case only if we assume that we share the same concepts. To quote Fodor, (1998, 29):

> RTM [representational theory of mind] takes for granted the centrality of intentional explanation in any viable cognitive psychology. In the cases of interest, what makes such explanations intentional is that they appeal to covering generalizations about people who believe that such-and-such […] In consequence, the extent to which an RTM can achieve generality in the explanations is proposes depends on the extent to which mental contents are supposed to be shared.

Others take the publicity of meanings to be necessary for successful acquisition of semantic knowledge. If meanings are private, how can we expect new language learners to acquire them accurately and reliably? Finally, public meanings spare us from positing shady mental entities whose explanatory usefulness is dubious in the eyes of many (i.e., Wittgenstein, Quine). If meanings are individuated by subject-external properties, their public character is assured. Subject-external properties are accessible to all *ceteris paribus*. In some cases, the access to these properties is indirect (i.e., via indirect causal connection or through the mediation of experts), but they are nonetheless public.

5.3 The problems of semantic externalism

My attack on semantic externalism will proceed in three steps. First, I examine three reasons why semantic externalism fails to provide a robust account of meaning individuation. Second, I take a closer look at the Twin Earth argument and expose why it is not conclusive evidence in favor of semantic externalism. Finally, I argue that semantic externalism is not required in order for communication or intentional explanations to be possible.

5.3.1 Meaning individuation

According to semantic externalism, subject-external properties play a crucial role in the individuation of meaning. Considerations pertaining to the creative aspect of language use reveal that major problems undermine this hypothesis.

There is an important tension between the creativity exhibited by human language use and the view that meaning is externally individuated. To the extent that language use is creative, it is implausible that meanings are delineated by environmental properties no matter how they are construed. Consider the case of assertibility condition semantics. According to this view, there are definite conditions for the appropriate use of a linguistic expression and these constitute its meaning. However, it is simply not the case that there are specific and definable assertibility conditions for the vast majority of linguistic expressions (Chomsky, 2002; McGilvray, 1998).[141] For any given linguistic expression, the set of conditions of appropriate use is open-ended and infinite. There is simply no generalization that will capture all of them. This is a point that Wittgenstein makes repeatedly in the *Investigations* (2000) and it seriously undermines interpretation of those who see his philosophy as an attempt to elaborate an assertibility conditions semantics understood as a *theory* of meaning. Wittgenstein recognizes that there is no way for philosophy to exhaust the meanings *qua* appropriate applications of linguistic expressions because linguistic expressions can be used appropriately in an incalculable number of 'language games'. At best, Wittgenstein believes that we can try to describe usage but we cannot elaborate a systematic and scientific theory of meaning or usage. While he is correct in his diagnosis of the hopeless nature of a science of language use, it does not follow that a science of meaning is impossible. Maybe a science of meaning is possible if we adopt a different theoretical approach, namely an internalist one. This will be my claim in part 3.

Theories that define meaning in terms of reference do not fare better with respect to the creativity of language use. The fundamental problem is that these

[141] We probably want to exclude logical connectives and other technical expressions (i.e., scientific notions, etc.). These are categorically different from the majority of linguistic expressions. More about why we should distinguish commonsense language and scientific language below.

accounts rest on a fundamental confusion between *what is meaning* and *how we use linguistic expressions* (Chomsky, 2000). That we use (some) linguistic expressions to refer to things in the world is undeniable. From this, it does not follow that their meanings are, or even could, be determined by what we refer to when using linguistic expressions. What makes it impossible is the fact that speakers are extremely creative when it comes to reference. Consider, for instance, the word “table”. We mostly use this expression to refer to objects constituted of a flat surface supported by four legs and that are used to support things. Yet, a rock on a mountain’s summit is a table if we intend to sit around it for lunch. A car trunk can be a table for those who want to eat sandwiches before attending a baseball match. I could go on with many other examples. Thus, we see that the reference set for “table” includes an indefinite number of disparate objects. The same situation holds for most linguistic expressions. Since the creativity of language users dictates to what an expression refers, its reference class is essentially open-ended and does not offer a satisfactory means of semantic individuation.

Also, it is worth pointing out that many linguistic expressions have no obvious referents. Among the problematic expressions we find empty kind terms (e.g., “phlogiston”, “witch”, “ghost”), fictional entity terms (e.g., “Santa Claus”, “Ulysses”), abstract notion terms (e.g., “justice”, “truth”), deitic expressions (e.g., “I”, “you”, “this”), prepositions (e.g., “for”, “to”), compounding expressions (e.g., “because”, “insofar”), and the list goes on. It is difficult to see how the meanings associated to these expressions can be individuated by subject-external entities, classes, or properties.

Because it relies on the notion of reference, truth-conditional semantics fails to provide the means for semantic individuation. According to truth-conditional semantics, the meaning of a statement is captured by the conditions that make the statement true. The truth-conditions are spelled out in terms of how the world must be for the statement to be satisfied. The legitimacy of truth-conditional semantics needs to be questioned if we can show that (a) truth-conditions fail to capture or are inconsistent with the meanings speakers associate to statements and (b) statements for which there are no ontologically real 'truth-maker' or definite truth-conditions can still be meaningful (Pietroski, 2005). Both phenomena are widely present in natural language because of the creativity of language use. Consider the following statement:

(11) The National Post is a right-wing broadsheet based in Toronto.

(11) is a perfectly meaningful and true statement. From the perspective of a truth-conditional semantics, the meaning that speakers associate to (11) would be something along the line of (12):

(12) "The National Post is a right-wing broadsheet based in Toronto." is true IFF there is a broadsheet, and it is right wing, and it is in Toronto and it is called the National Post.

But as many have argued (Chomsky, 2000; Pietroski, 2005), it is rather improbable to believe that speakers using (11) mean that there are physical objects of the broadsheet newspaper type that have the property of being right wing. Indeed, being right wing is not the kind of property that a stack of folded paper can possess; it is a property that only certain types of cognitive entities can exhibit. So, a speaker could reject the truth of (13) and yet accept (11) as true.

(13) Broadsheet papers *qua* physical objects can have right wing political opinions

But according to truth-conditional semantics, (11) cannot be true unless (13) is true. Thus, truth-conditional semantics mischaracterizes both the meaning of (11) and the understanding that speakers have of (11).

The problems of truth-conditional semantics can be approached from a different perspective. It only makes sense of talking of a statement being true if there is something that actually makes it true. In other words, our talk of truth is tied to ontology. To say that a statement is true in the absence of a 'truth maker' is incoherent. As Pietroski (2005) shows, the creativity of language use forces many philosophers of language into a position of incoherence. Borrowing one of his examples, if you want to claim that (14) is true in the commonly understood way— namely that (14) is 'satisfied' by the world—then you ought to be ontologically coherent and accept that there is at least one republic that has an hexagonal shape.

(14) France is hexagonal, and it is a republic.

If you balk at allowing hexagonal republic in your ontology because, strictly speaking, a republic *qua* political system is not something that can have a shape, then what is meant by 'true' is something distinct from the commonsense concept, which revolves around the notion of correspondence with ontologically real entities.

The problems encountered by truth-conditional semantics are a direct consequence of the creativity of language use. Speakers use language in ways that that cannot be captured simply in terms of truth, truth-conditions, etc. To quote Pietroski (2005, 72)

> [And] notions like 'truth' may not make the right theoretical cuts for purposes of explaining the facts that semantic theories explain.

Before moving on, I want to consider how proponents try to circumvent some of the previous objections. In what follows, I will focus on recent solutions semantic externalists offer to the problem posed by empty kind terms.

One strategy consists in arguing that the meaning of an empty kind term is defined by the very fact that it refers to nothing. The meaning of "water" is individuated by the specific stuff, H_2O, found in the environment. For words like "ghost" or "square-circle", what individuates the meaning of these expressions is that they designate nothing. There are at least two reasons why this strategy fails. First, all empty kind terms share the same 'referent', namely the null set, or nothing.[142] The semantic externalist holding this view now faces a dilemma. If the meaning is individuated by subject-external properties and empty kind terms have the same individuating property (i.e., nothing), they all share the same meaning. This is absurd. To the extent that we assume that empty kind terms do not have the same meaning, then meaning individuation cannot depend on reference (i.e., nothing).

A second argument against the hypothesis that empty kind terms are individuated by their 'reference to nothing' is found in Segal (2000). If empty kind terms are rigid designators of the empty set, then this holds for all possible worlds. In short, it is a necessary fact of empty kind terms that they refer to

[142] I am entirely aware of the awkwardness of considering nothing as something that can be referred to.

nothing. Thus, it cannot be the case that in some possible worlds the word "witch" refers. According to Segal, such a conclusion goes against our modal intuitions. We can imagine a possible world where we find witches and in which world the word "witch" does not fail to refer. Because it burdens us with counter-intuitive necessity statements, Segal suggests we reject this solution to the empty kind term problem.[143]

A different solution to the problem of empty kind terms posed to semantic externalism involves modifying our ontology. One way to do this is to posit the existence of possible worlds. Another is to affirm the existence of abstract objects (Salmon, 1998). Let's consider the first suggestion. While there are no ghosts in this possible world, we can imagine possible worlds where such entities exist. If we grant this, we can say that the word "ghost" refers to those entities in possible worlds where there are ghosts. To put this in truth-conditional terminology: the expression "ghost" is satisfied by the set of possible worlds where there are ghosts.

One problem with this argument is that unless you take possible worlds to be ontologically real, then meaning is not individuated by subject-external properties. For many, cluttering our ontology with possible worlds is too steep a price to pay. One can also question whether it is sensible to assume that the semantic knowledge of competent language users involves modal considerations. How can we expect children to acquire such semantic facts in the first place?

[143] Segal's defends an internalist account of meaning. He argues that it allows to circumvent the problem raised by empty kind terms.

Finally, there is the issue raised by linguistic expressions that do not refer in any possible world like “square-circle”.

Salmon’s solution involves positing the existence of abstract entities to which empty terms refer. To borrow an example (not a kind term however) used by Salmon, the expression “Sherlock Holmes” refers to an abstract man-made entity, namely Sherlock Holmes. The main reason why he thinks we should adopt his revised ontology is that it allows us to make sense of our truth conditional intuitions about sentences with empty terms.[144] Salmon’s Meinongian ontology strikes me as completely implausible. It is driven by his unflinching commitment to semantic externalism, no matter the ontological costs. Before going to such extremes, one should probably consider changing one’s semantics. Reimer (2001) also points out that the sentence (1) turns out false if we accept Salmon’s suggestions, which is very strange indeed.

(1) Sherlock Holmes does not exist.

Devitt and Sterelny (1999) and Donnellan (1974) think that the causal-historical framework offers the necessary tools to deal with the problem of empty kind terms. We can assume that the word “ghost” entered the English language at one point in time through some kind of christening ceremony. But unlike christening events for non-empty kind terms, there was nothing actually being named in the case of “ghost”. While there was no object being named, a causal

[144] From personal communication quoted in Reimer (2001, 8): “The main reason to acknowledge the existence of fictional characters and the like…is that doing so provides the most plausible explanation for the truth (which is presumed) of such sentences (which we frequently do utter) as ‘There is a fictional detective who (according to the story) is addicted to cocaine, but there is, at least as yet no fictional detective who (according to the story) is addicted to banana peels’ –and other sentences (i.e., as uttered by authors, literary theorists, film critics, etc.) making apparent reference to fictional characters”.

chain was initiated by this ceremony. From that moment on, a certain use of the expression “ghost” was causally transmitted. This causal chain (i.e., the naming event and the causal transmission) is a subject independent property. According to Devitt, Sterelny and Donnellan, it constitutes the reference of the expression “ghost”. One problem with this proposal is that it amounts to a reformulation of the thesis that meaning is individuated by a specific use. The initial use of the expression in the naming ceremony with the causally transmitted use determines the meaning of “ghost”. But since use is creative, past use does not constraintfuture use. Hence, the meaning of “ghost” is not captured.

Finally, I want to turn to Putnam’s proposal (1994) on this question. Recall that he argues that meaning is best understood as a ‘vector’ consisting of various components like syntactic markers, semantic markers, stereotype and extension. In the case of empty kind terms, three of the four vector’s elements are filled. But this is sufficient for meaning individuation, according to Putnam. Thus, Putman deals with the problem by adopting a ‘two-factor’ (Segal, 2000) semantic theory. Putnam’s two-factor approach has failed to convince some fellow semantic externalists. Some see in the notion of stereotype an internalist remnant that should be discarded in favor of a fully externalized account of semantic individuation (Burge, 1993). I think the real problem lies elsewhere. Putnam’s notion of stereotype understood as a representation of the salient features of the paradigmatic members of a group (for a given population of speakers) is simply insufficient to individuate meaning adequately. Meaning individuation requires something that is both more fine-grained and categorically different than salient features that can be abstracted by observing what a population of speakers takes to be paradigmatic cases (McKay, 2005). What exactly is needed will be discussed in Part 3.

5.3.2 Twin Earth

The Twin Earth thought experiment plays a central role in the argument for semantic externalism. The intuitions it generates are believed by some to provide an unassailable demonstration that meaning must be externally individuated. There is a certain intuitive appeal to the claim that "water" in English cannot have the same meaning as "water" in Twin-English since they refer to different substances. I want to argue, however, that these intuitions should not drive our theory of meaning.

Putnam's Twin Earth thought experiment is built around natural kind terms like "water" and "tiger". Natural kind terms, especially those used by Putnam, are somewhat atypical since they straddle the line between science and common sense. Some argue (Chomsky, 2000, McGilvray, 2003) that there is a discontinuity between scientific and commonsense concepts—that they are the products of different cognitive capacities (i.e., 'the science forming capacity' versus 'common sense understanding'). The fundamental differences between scientific thinking and common sense thinking justify positing the existence of different cognitive faculties. One becomes capable of sophisticated scientific thinking within a specific domain after a long and arduous education process. Scientific thinking involves a radical shift from our everyday perspectives on things (among other things, positing unobservable entities). Scientific concepts are created to meet specific theoretical and empirical requirements. All of this is quite unlike what we can observe in non-scientific, common sense thinking. Common sense thinking does not require the kind of training associated with science. It comes naturally to all of us and its properties are fairly stable across the human species. Across all human populations, folk-physics (Spelke *et al.*, 1992), folk-biology (Atran, 1990) and other folk 'theories' share fundamental, abstract and non-trivial similarities. The concepts used in common sense thinking are not invented nor are they regulated by theoretical and empirical constraints. Instead, these commonsense concepts are structured according to guidelines that appear to be largely innate and beyond conscious control.

The natural kind term "water" is ambiguous since it is both a commonsense term and a term that is used by scientists. In the case of scientists, the semantics of "water" involves a number of theoretical assumptions that are absent from the laypeople's semantics of the term. While scientists might use "water" informally in certain situations, they recognize "water" as a specific kind of kind term, namely a chemical kind term whose meaning is determined by the best chemical theory about a particular molecule built from hydrogen and oxygen atoms. From the scientific perspective, the goal is to provide a description of nature that is as accurate and objective as possible. As a result, it often proves useful (but not always) to define substance terms in terms of microstructural properties. In the end, chemistry defines what "water" *qua* scientific natural kind means and nothing else. In a scientific context, Putnam's claim that meaning is set by reference seems roughly accurate. Since *scientists* choose to distinguish substances based on their microstructural properties because this is theoretically fruitful, then scientists on Earth and Twin Earth do not mean the same thing by "water". English "water" and "water" in Twin English are homophonous but not synonymous because they refer to different chemical substances.

The situation is dramatically different when we consider "water" as a commonsense concept. As Chomsky (2000) convincingly demonstrates, what counts as water from the commonsense perspective is not determined by theories elaborated by scientists. In particular, microstructural properties are essentially irrelevant in fixing the meaning of "water" for laypeople. In fact, it could be argued that the commonsense concept [water] is inconsistent with the scientific concept [water].

Chomsky gives the following examples. Water taken from your typical North-American river contains more impurities than the average cup of tea made using tap water. Nonetheless, the first liquid is considered water and not the second. Imagine that a city decides to use tea filters at the pumping station to eliminate a certain kind of bacteria. The liquid that now comes out of the tap tastes like tea; but people in the city still consider the liquid to be water nonetheless because they use it as water (e.g., to wash, to cook pasta, etc.) Bear in mind that something quite analogous happened when cities started using chlorine and other chemical products to purify water. These chemicals not only modified the chemical composition of the liquid referred to as "water" but it also modified its taste. Yet, people still take the liquid coming out of the tap to be water.

From the standpoint of common sense, the meanings of "water" and of other natural kind terms are individuated by a multitude of criteria that have nothing to do with microstructural properties. The origin of the stuff and its function in human use enter the equation. Hence, it is not a conceptual error to hold that "water" has the same meaning on Earth and Twin-Earth even if they refer to chemically different liquids, *pace* Putnam.

Segal (2000) offers a different argument to demonstrate that the intuitions generated by Putnam's Twin Earth thought experiment should not be used to make generalizations about the nature of meaning. Segal argues that if we use different kind terms to set up the Twin Earth thought experiment, we can generate intuitions that contradict semantic externalism! To prove his point, Segal introduces the natural kind term "bekong". A bekong is a kind of ghost with particular properties: it can be encountered in dreams, it contacts humans by means of various signs, etc. Now, imagine two Twin-Earths (i.e., $Earth_2$ and $Earth_3$) that differ from Earth in the following ways. On $Earth_2$, "bekong" refers to real entities; they appear after a transformation process, call it T_2, that takes place after bodily death. On $Earth_3$, "bekong" refers to real entities too; but the process by which they appear is different, call it T_3, since it takes place before bodily death. Bekongs on $Earth_2$ and $Earth_3$ share all other properties. Given this setup, does "bekong" have the same meaning on both planets? In this case, our intuitions are not as clear cut. Segal correctly points out that many will not accept the conclusion that the meaning of "bekong" is different on $Earth_2$ English and $Earth_3$ English.

In the same vein, Segal attacks the idea that the practices of experts or social groups generally can be used to individuate meaning. He holds that this view leads to some incoherent consequences. According to Putnam, one can possess a word's meaning, say "gold", even if one is not a reliable gold detector (e.g., would confuse gold and fool's gold). It suffices for the speaker to defer to experts for the extension of “gold” to know the accurate meaning of the expression. Furthermore, Putnam holds that the expert and the deferent layperson associate the same meaning to “gold”. Segal thinks that this conclusion is erroneous. Consider the following thought experiment. John is unable to distinguish elms from beeches. When he needs to differentiate these trees, he turns to experts. If Putnam is correct, John and botanical experts associate the same meaning to “elm”. It so happens that botanical experts use the expression “ulmus” as a synonym for “elm”; “ulmus” and “elm” have the same meaning for them. Imagine that John learns the word “ulmus”. For the reference of “ulmus”, he defers again to experts. For Putnam, John and the experts share the same meaning for “ulmus”. *Ex hypothesis*, let’s assume that John is not aware that “elm” is synonymous with “ulmus”. This means that John has two different entries in his lexicon: one for “elm” and one for “ulmus”. Thus, “elm” and “ulmus” do not mean the same thing for John. But here we have a paradox! According to Putnam, John’s semantic knowledge is identical to the experts’ knowledge, and yet this is not the case. Experts know that “elm” and “ulmus” mean and denote the same thing, but not John.

While Segal’s arguments are ingenious, they often rest on intuitions that people purportedly have about semantic issues. But philosophers have many reasons to question the relevance and to reassess the role played by intuitions in building a theory of meaning. As I mentioned above, the semantic intuitions generated by the Putnam-style and Kripke-style thought experiments vary across cultures (Machery, Mallon, Nichols and Stich, 2004). As such, Putnam’s and

Kripke's personal intuitions do not reveal anything fundamental about how humans as a species think of the meanings of the natural language terms.

From a methodological point of view, if philosophers insist on using 'lay intuitions' in their semantic research, they should be rigorous in gathering data. It is not sufficient to do a bit armchair psychology and poll (or convince) their colleagues in philosophy departments. One can only discover folk intuitions about semantic issues by building methodologically sound surveys and polling a wide enough population. Some philosophers, who call themselves *experimental philosophers*, have adopted a more scrupulous approach and their results are not always consistent with the intuitions philosophers believed were universal.[145] A more fundamental issue, one I have raised a few times already, concerns the assumption that folk intuitions about semantics are relevant to the project of a theory of meaning. In most domains of theoretical inquiry, folk intuitions are not considered to be the final criteria for truth. They might be used as a starting point for reflection, but they are quickly replaced by other evidence (e.g., experimental results, etc.) to fuel the advance of research. There is a recognition that the world is most likely more complicated than folk intuitions tell us, and that we need concepts and theories that go beyond what folk thinking has to offer if we want to achieve an adequate comprehension of phenomena. It is difficult to conceive why the situation should be different in the case of language and meaning. Many philosophers do argue that language and meaning are exceptional in nature and this justifies focusing on folk intuitions. But given the theoretical results that this

[145] See Knobe (2003) for an example of this approach.

approach has offered so far –very few!—we are entitled to question the soundness of this research strategy.

5.3.3 Meaning and publicity

Do we need to assume that meanings are public in order to guarantee the success of communication? How we answer this question depends in part on how we understand the problem of successful communication. For some, the problem is akin to the problem of other minds and it constitutes a kind of skeptical challenge. A satisfactory solution is one that will convince a hard-nosed skeptic by providing indubitable evidence. However, the problem does not have to be interpreted in this way. One can start with the assumption, which seems quite reasonable, that communication is indeed sufficiently successful and try to describe the systems involved in the process. The problem is not one for epistemology but for cognitive sciences.[146] I think that the need for public meaning comes largely from understanding the problem of successful communication as one of epistemology. If we can show that we share the very same meanings, then it becomes easier to deal with skeptics. But if we ignore the skeptical problem, then the requirement of meaning publicity becomes optional. As many have argued (Davidson, 1986; Chomsky, 2000), communication can be successful even if interlocutors do not share exactly the same semantics. What is required is that both interlocutors share sufficiently similar meanings and have the capacity to agree on some 'passing frame of interpretation'.

Fodor (1998) rejects this last proposition. He argues that semantic similarity depends ultimately on semantic identity. Two things can only be

[146] Fodor (1998) makes this distinction.

similar if they share at least some identical properties. This holds for similarity between meanings. We are back where we started: we need to account for the possession of identical semantic properties by different interlocutors. Public meanings make it possible for different speakers to share the same meanings. However, publicity is not the only way out of Fodor's trap. One can deal with this problem without having to individuate meanings externally. If all speakers share a set of internally individuated semantic primitives out of which more complex meanings are composed, then we can salvage the notion of similarity. When we say that interlocutors share similar meanings, we should understand that meanings share identical semantic constituents. This account only works if we can provide a satisfactory explanation of why we have come to share a common stock of semantic primitives. Moreover, we must demonstrate that complex meanings are in fact structures built using a finite set of semantic primitives. I think there are reasons to believe that this is actually the case, and I examine them in Part 3.

The success of intentional explanations does not require a commitment to public meanings either. To the extent that humans are cognitively similar because of our shared biological endowment, the explanatory robustness of folk-psychology should not be too surprising. This being said, one must be careful not to overestimate the explanatory potential of folk-psychology. While intentional explanations can shed light on actions, we cannot expect, *contra* Fodor, that they will be the foundations of a genuine science of human psychology.

Lastly, acquisition of semantic knowledge does not require that meanings are public. I show this in Part 3.

Part 3

Biological Rationalism

Part 1 of this dissertation attacked empiricism as a theory of language acquisition. Part 2 questioned the soundness of externalism in its various guises, namely functional, ontological, epistemic and semantic. In this third and last part, I want argue that if we approach language from a nativist and internalist perspective, we can avoid the problems faced by empiricism and externalism. Only if we adopt this change of perspective can we hope to gain a genuine understanding of language that reaches the highest philosophical and scientific standards.

A number of people have been working on developing a nativist and internalist theory of language. Among them, Noam Chomsky is most certainly the person who contributed the most to the progress of this approach. What follows belongs to the research program that Chomsky revived in the 1950s and has constantly been developing ever since. The program has received many names from friends and enemies. Some of them prove misleading (e.g., 'The innateness hypothesis') and others do not fully express the breath of the program (e.g., generative grammar). One label that seems felicitous is *biological rationalism*. It captures the two essential features of the research program. First, there is the idea that language is fundamentally a natural object, a *biological* *organ* in fact, and that it should be approached as such when trying to understand it. It is a natural object of a special kind since it realizes a specific cognitive competence, namely linguistic competence, which is largely independent of subject-external conditions for its acquisition, development and individuation. Biological rationalism as a research program is the merger of the rich rationalist philosophical tradition (e.g., Plato, Descartes, Cudworth and others)[147] with contemporary biology. The end result is a genuine 'science' or 'natural philosophy' of language.

Part 3's organization follows the order in which topics have been discussed so far. I start by describing the biological rationalist hypothesis about language acquisition. Afterwards, I examine the internalist account that biological rationalism opposes to the prevalent externalist doctrine.

1 Language acquisition: biological nativism

We know that the child acquires language on the basis of evidence that is severely impoverished. The primary linguistic evidence is incomplete and ambiguous. Nonetheless, the child succeeds in acquiring complete linguistic competence rapidly. These empirical observations raise a crucial question: How can a child learn language if she has access to insufficient evidence?

Chomsky (1986) calls this 'Plato's Problem' because Plato is puzzled by a similar problem.[148] He wonders how we acquire the knowledge of concepts such as [equality], [triangle], [justice], etc. based only on encounters with imperfect representations. Since all triangles we perceive always come up short of realizing

[147] Chomsky examines the intellectual genealogy of contemporary biological rationalism in *Cartesian Linguistics* (2002).
[148] Plato's *Meno* offers a discussion of this problem.

the concept [triangle], we cannot learn [triangle] by induction over such deficient exemplars. Faced with this problem, Plato makes a bold hypothesis. If we know these concepts but we cannot 'learn' them, then they must already be in our mind. What we describe as 'learning' is in fact nothing more than accessing concepts that are latent in our mind. When we encounter triangles, their similarity with the concept [triangle] is responsible for a process of *recollection*. Reminiscence transforms latent conceptual knowledge into conscious conceptual knowledge. Plato argues famously that we acquire this latent conceptual knowledge when the soul was roaming the 'heaven of forms' before being trapped in the body.

Plato's assumption –if a concept is understood and used, yet could not have been learned given the evidence and training received, it must already be in the mind–is at the heart of biological rationalism. Obviously, contemporary biological rationalism rejects Plato's doctrine of recollection. Yet, he is correct in his grasp of the explanatory challenge we face. Furthermore, he has the correct intuition as to where we need to turn to in order to solve it: inside the human mind. If the evidence found in the environment is insufficient to acquire language, then the child must be bringing what is lacking to the table. The task of those interested in understanding language is, therefore, to discover and describe the child's contribution to the process of language acquisition.

The idea that the child is filling in the gaps in the primary linguistic evidence using inner linguistic resources is anathema in empiricist quarters. Still in thrall to the idea that the human mind is 'a vessel to be filled by experience', the hypothesis that the child has access to linguistic knowledge that is not acquired based on experience is unacceptable. Moreover, biological rationalism is perceived as an avatar of a pre-scientific era when a priori arguments still had authority over empirical considerations in the enterprise of understanding nature. It is crucial to dispel this inaccurate perception.

Biological rationalism is a thoroughly naturalistic research strategy. Confronted with a number of facts about language acquisition, it offers a research program: language acquisition is possible only because the child has already available to her linguistic resources that are biologically predetermined. This is a hypothesis that must be assessed empirically, and this is something that all contemporary biological rationalists recognize. Whether or not this research program is worth pursuing depends on how the hypothesis fits with and explains the facts. It is clear: contemporary biological rationalists are not in the business of a priori arguments. This constitutes one important difference between biological rationalism and Kantianism. These positions are sometimes confused, but this is a mistake. Kant (1994) argues for forms of intuitions, the categories of understanding and the ideas of Reason by relying on a priori considerations. This is not the case for biological rationalism.[149] Theoretical claims are grounded in empirical considerations and are empirically falsifiable.

1.1 Defining Innateness

Contemporary biological rationalism defends a nativist hypothesis. The child relies on language specific *innate* resources to make up for the poverty of the linguistic evidence in the environment. Historically, most rationalists offered

[149] Cowie (1998) is guilty of confusing contemporary biological rationalism and a prior rationalism. She thinks that the so-called ‘logical argument’ for linguistic nativism is an a priori argument. It is not. While the label opens the door to confusion, the argument itself is entirely naturalistic. Based on an analysis of the evidence she has access, the argument states that it is logically impossible for the child to attain fluency based on induction alone.

a non-biological account of innateness (i.e., Plato, Descartes, Cudworth). Biological rationalists endorse biological nativism. Innateness is cashed out in terms of biological endowment. The notion of innateness has been under constant attack since the heydays of behaviorism. Many claim that it is in 'disrepute'. It is a throwback to the time of 'instinct psychology', and it is incompatible with our best understanding of the complex interaction between genes and environment. From a philosophical perspective, innateness is also suspicious because it cannot be defined precisely. To the extent that biological rationalism is committed to innateness, I must address these objections.

I believe critiques are correct when they complain that different people mean very different things by "innateness". Bateson (1991, quoted in Griffiths, 2002) distinguishes 7 different senses of "innate" and Griffiths adds an eight one:

- Present at birth
- A behavioral difference caused by genetic difference
- Adapted over the course of evolution
- Unchanging through development
- Shared by all members of the species
- Not learned
- A distinctly organized system of behavior driven from within
- Something that can be taken as given with respect to the set of causal factors currently under investigation.

Griffiths (2002) argues that these 8 definitions fall under one of three general headings: (1) developmental fixity, (2) universality and (3) evolutionary origin. The problem, he argues, is that one cannot infer reliably the presence of the other properties from the presence anyone of them. For example, evolutionary origin does not necessarily entail developmental fixity or universality. To the extent that "innateness" subsumes all these different properties, it is not a coherent scientific notion according to Griffiths

I think one can offer a definition of innateness that is both empirically sound and heuristically useful that avoids the kind of confusion Griffiths loathes. First, we need to be clear on the nature of *what* is innate. Generally speaking, we talk of *traits* being innate. It is important to understand this notion in a sufficiently broad fashion. Having two arms and two legs is a trait. A behavior can be a trait. But possessing a specific kind of cognitive architecture, which might not be readily observable and can only be discerned by means of complex scientific inquiry, is also a trait. In short, a trait is a *property of an organism*. What distinguishes traits that are innate from non-innate traits is the fact that their development and their structure are by and large determined by constraints that are internal to the organism. Obviously, the realization of innate traits requires that certain environmental conditions be fulfilled. Without adequate environmental conditions (nutrition, etc.), the innate human trait of developing two arms and legs will not be expressed. However, in the case of an innate trait we can distinguish the driving force behind its development and structure is largely internal to the organism.

This will not satisfy opponents of innateness because they reject the idea that one can factor out the influence of internal constraints from environmental constraints. Maclaurin (2002) points out that while it might be difficult to distinguish the respective *causal contribution* of the environment and internal constraints, it remains possible to distinguish their relative *informational* contribution. One way to demonstrate this is by having recourse to possible worlds. For a determined set of possible worlds, environmental conditions will never be sufficient for the expression of a trait that is innate. On the other hand, for the same set of possible worlds, internal constraints are both necessary and sufficient for the expression of an innate trait. Consider the following example. For a set of possible worlds that are similar to our own, the absence of the Hex-A gene on chromosome 15 is a necessary and sufficient condition for the development of Tay-Sachs disease. Environmental conditions are necessary but are never sufficient for the development of the disease. This difference shows that internal constraints, in this case a genetic disorder, are the driving force in the development and structure of the trait, namely Tay-Sachs disease.

This definition of innateness focuses on the fact that the development and properties of certain traits are determined largely by inner constraints. The same point can be made from the opposite perspective: the structure and development of innate traits are largely impervious to environmental conditions (at least within definable limits). Here, we see that the notion of innateness meshes with what Waddington and others have called 'canalization'. Canalization occurs when processes are

> adjusted as to bring about one definite end result regardless of minor variations in conditions during the course of the reaction, [thus ensuring] the production of the normal, that is optimal type in the face of unavoidable hazards of existence. (Waddington, 1942, in Chomsky, 2005, 5)

Whereas canalization stresses the fact that the development of innate traits are buffered from environmental variances, the way I have explained innateness focuses on the origin of the structural and developmental constraints. These two accounts are compatible; they are in fact the two sides of the same coin.

As understood here, the notion of innateness is to be dissociated from some of the senses listed by Bateson and Griffiths. Saying that a trait is innate does not entail that it is present at birth. The development of an innate trait might happen at any time in the life of the organism. An innate trait is not necessarily an adaptation since not all internal constraints are the product of selection and adaptative. An innate trait can change through the organism's development. All members of a species do not necessarily share it since it might be the result of internal constraints possessed by a unique individual. As I pointed out already, an innate trait does not necessarily have a behavioral expression. I leave the question of the relationship between innateness, learning and acquisition aside for the moment. I will return to it below.

More needs to be said about what I have called 'internal constraints'. The genetic endowment is the source of most internal constraints that affect the development and the structure of organism-specific traits. What is being claimed here is *not* that all the properties of innate traits are genetically encoded. While it might be the case, it is also entirely plausible that the interplay between genetic constraints and other constraints acting on the organism's development contribute to the specific properties of traits. Non-genetic constraints that can influence the characteristics of innate traits are physical/chemical constraints, informational constraints and developmental constraints. In recent years, Chomsky (2005) has been investigating how what he calls the 'third factor' might be involved in the development and structure of innate linguistic resources. The third factor subsumes non-genetic constraints that delineate development and structural possibilities of biological systems. For example, D'Arcy Thompson (1917) argues that physical constraints precluded the development of certain body forms. Similarly, Alan Turing (1952) claims that chemical constraints might explain why certain types of organic organization are prevalent in nature. It could be argued that these other factors are not truly 'internal constraints' since they are not internal to the organism itself. But they are not 'external' in the usual sense either. What they do is *modulate* the expression of the genetic endowment, which is the fundamental driving force responsible for the organism's development.

The idea that some traits are driven by genetic, developmental, informational and physical/chemical constraints, is uncontroversial when it comes to non-human animals. It is when similar claims are made about humans that we encounter resistance. Given our biological genealogy, there is little reason to expect that we should differ from other animals on this point. This is obviously an empirical hypothesis that needs to be tested. But it seems safe to accept it as our starting hypothesis. Chomsky (2000) argues (correctly, I believe) that opposition to innate traits in humans emanates from a still unresolved belief in mind-body metaphysical dualism. Furthermore, innateness is seen as undermining human freedom, which is unpalatable for many.[150] However, such considerations should not lead to the rejection of the possibility of innate traits in humans. First, metaphysical dualism is an extremely weak position in the light of our best science and philosophy. Second, it is far from obvious that freedom and

[150] See also Pinker (2002) for a discussion of this issue from a different perspective.

innateness are irreconcilable. In fact, innate traits might be required in order to have freedom (Chomsky, 2002).

So, biological rationalism holds that language acquisition is made possible because of the contribution of innate resources (i.e., resources whose development and structure are determined by internal constraints) that offsets the impoverished linguistic evidence available in the environment. Over the last 60 years, biological rationalists have tried to specify what those innate resources must be. Their work has been guided by the desiderata discussed in Part 1. Thus, the innate resources must enable the acquisition of all human languages with all their differences given the minimal amount of evidence on the basis of which children actually succeed in acquiring language. In technical terminology, the criteria of descriptive adequacy and explanatory adequacy must be met. The innate resources postulated must be biologically and cognitively realizable. These general guidelines make a certain number of hypotheses unlikely right off the bat. For example, what makes up the innate resources cannot be an internalized version of the English syntax since this would be of little use to a child learning Japanese or Finnish. Those working in the biological rationalism framework also assume that the innate resources at play in language acquisition are language specific. This is an empirical assumption that has been supported by empirical research and that has generated a theory about what internal constraints are required for successful language acquisition. It is a theory about the 'initial state' of the child's 'language organ', which is known as *Universal Grammar*.

1.2 The Language Organ and Universal Grammar

The central insight of biological rationalism is the claim that human beings, because of the constraints imposed by their biological endowment and the 'third factor', possess innately what has become known as *Universal Grammar*. Universal Grammar (UG, for short) enables the child to overcome the poverty of stimulus conditions and acquire language with the ease and speed we observe. The nature of UG has been a source of various misunderstandings and this has led to serious confusion in discussion about the topic. In fact, the confusion goes a long way towards explaining the resistance that many have towards the idea of UG. Once it is properly understood, UG is a fairly uncontroversial naturalistic hypothesis that can be assessed like any other scientific hypothesis.

UG is an innately specified developmental program. It is a specialized instruction set that is dedicated to a specific task, namely language acquisition. The process of language acquisition made possible by UG results in the development of the 'language organ' (henceforth, LO). The use of 'organ' in this context should not be understood metaphorically. The product of the language acquisition process is the 'growth' of a language organ with specific properties –a specific I-language in Chomsky's terminology. The properties that the LO attains are a function of the interaction between the constraints imposed by UG and the linguistic evidence processed. Put differently: UG is the 'initial state' of LO whereas the language acquired is the 'steady state' achieved by LO once the process of 'growth' is completed. Most biological rationalists (Chomsky, 2000; Anderson & Lightfoot, 2002) consider that language is an organ on par with other biological organs like the heart or kidneys. Those seeking to describe and understand LO and UG are engaging in 'physiology' (Anderson & Lightfoot, 2002).

The idea that language is an organ and UG is one of its developmental state has struck many as strange and plainly wrong. No one (except dualists) will question the fact that language is made possible by biological structures like the brain and that some parts of the brain might play a more important role than others in this task. But from this one is not entitled to conclude –they claim—that there is an organ dedicated to language, nor a language-specific developmental program. The notion of organ is used to refer to biological systems that are structurally and functionally self-contained to some relevant degree. According to this view, the heart is rightfully considered an organ because it has a structural unity (i.e., a four-chamber muscle) and a functional unity (i.e., pump for blood). Opponents of the LO hypothesis claim that there is no structurally and functionally self-contained structure in the brain that is dedicated to linguistic tasks. They argue that the brain's plasticity is incompatible with the idea that one brain region or even some regions are dedicated to language (Elman et al., 1995). Thus, talk of 'language organ' is wrong.

I believe that none of these considerations seriously undermine the biological rationalist hypothesis that language is an organ. The first point that must be kept in mind is that the notion of organ involves a certain amount of idealization. Take the example of the heart. When we talk of the heart being an organ, we isolate it from the rest of the circulatory system. However, the heart cannot operate independently and it is structurally related to the rest of the circulatory system. We focus on the heart and abstract away from certain structural and functional details because it proves explanatorily and heuristically useful.[151] The situation is identical in the case of LO. When we talk of language as an organ, the claim made is that it is explanatorily and heuristically useful to assume that there is an autonomous biological sub-system in the brain dedicated to language. For example, it provides an explanation for cases of competence dissociation involving language and other cognitive skills; these are the results of breakdowns that selectively affect LO. It sheds some light on why damage occurring in some areas of the brain and not others cause linguistic impairments; these areas play a role in the activity of the language organ. Finally, assuming the existence of an organ dedicated to language that is shared by all humans fits nicely with facts about language acquisition like its universality, its ease, etc.

The LO hypothesis does not commit us to the following claims. First, the organ need not be located in one anatomical area of the brain or be continuous. It is entirely possible that LO is a 'distributed organ', which involves many distinct subsystems that operate in coordination. Evidence from neurology shows that 'circuits' and 'pathways', which cross many anatomical structures in the brain, are common. Second, positing the existence of a language organ is not inconsistent with neural plasticity. In principle, we can imagine other structures of the brain taking over functional tasks inherent to LO brain structures in the event of injury. In fact, it is conceivable that LO is multiply realizable by different neuroanatomical structures in different subjects. One could still rightfully talk of 'organ' if it proved explanatorily and heuristically useful. Two caveats however.

[151] Cultural matter might be at play here. In our society, the heart is perceived as the center of emotions. This might contribute to its status.

First: given our common biological endowment, multiple realizability appears highly unlikely. Second: one must be careful not to overstate the phenomenon of plasticity. It is simply not the case that the brain can rewire itself to cope with all types of injuries. Focusing on the case of language, there is ample evidence that the work achieved by certain neural circuits and areas cannot be taken over by other neural structures. Because of our lack of knowledge about the brain, it is very difficult to affirm anything about how LO might be anatomically realized. But this in itself does not invalidate the assumption that language is an organ. It is simply an invitation to investigate the matter further. [152]

Unlike the heart whose action is essentially physical (i.e., it pumps blood), LO's activity is computational. What LO contributes to the human organism is a specific type of computational capacity that plays a crucial role in the production of language. It does so by implementing specific algorithms 'that take[s] experience as "input" and give the language as an "output" –an "output" that I internally represented in the mind/brain' (Chomsky, 2000, 4).[153] At the present, biological rationalists are mostly focusing on describing the specific computational properties of LO (i.e., describe the initial state of LO by producing a theory of UG). In doing so, they are doing physiology at a very high level of abstraction, but it is physiology nonetheless. The hope is that one day we will be able to study LO at the neural level, but there is little hope of breakthroughs in the near future because of our current lack of understanding of the brain's structure and the limits of non-invasive brain study.

[152] Samuels (1998) considers the questions raised in this paragraph in more details.
[153] I will address below the issue surrounding Chomsky's understanding of the concept of representation.

Biological rationalists assume that LO is *modular* from a computational perspective. It is important to specify exactly what is meant by this expression. It is *not* modular in Fodor's sense (Chomsky, 2000, 117). Indeed, Fodor reserves the concept of module for input systems (i.e., ones that generate representations based on sensory input) and output systems (i.e., pass command from the central system to peripheral systems). LO is neither an input nor an output system in Fodor's sense. But like Fodorian modules, LO is domain specific. It deals only with linguistic tasks, and it does so relying on algorithms that are unique to it. Operations taking place *within* LO are invisible to other systems, but LO does interact with other cognitive and physical systems by means of *interfaces* about which we will have more to say. Lastly, LO is mandatory insofar as language acquisition and production necessarily rely on its resources and are determined by its unique constraints.

A theory of UG seeks to describe in the most accurate way the initial properties of LO at the neural and computational levels. Over the years, the theory has evolved and sometimes changed radically. The current minimalist approach has discarded certain notions and principles found in *Aspects* (1965), and those that are retained have been reconceptualized. Some see in the successive transformations of the theory of UG the evidence that the biological rationalist program is a failure (Searle, 2002). This objection is completely unfounded. To the extent that biological rationalism and, especially, the UG hypothesis are empirical hypotheses, we can expect changes to occur that will reflect our increasing understanding of language and its acquisition process. No one would seriously consider discarding the atomic theory of matter because it has undergone some fundamental transformations. Obviously, something must remain relatively stable throughout all the incarnations of a given theory if we are to talk of ‘a theory evolving’. In the case of biological rationalism, what remains constant throughout all its forms is the fundamental research assumption that language acquisition is only possible if we posit the existence of language-specific innate resources. The exact nature of the language-specific innate resources, what is generically called UG, is what we set out to discover by conceptual and empirical inquiry. The hope is that our understanding of UG is progressively increasing, building upon both the successes and the failures of previous research.

My description of UG’s properties will follow what is considered today to be the state of the art account: the *Principles and Parameters* hypothesis (henceforth, P&P).[154] P&P is the attempt by linguists working within the biological rationalist research program to resolve the tension between two opposing tendencies. Casual observation seems to indicate that human languages differ significantly along various dimensions (i.e., syntax, morphology, phonology, semantics). To account for this linguistic diversity, one can hypothesize that UG is extremely complex and contains a great deal of information specific to individual human languages. However, a number of considerations make this scenario unlikely. Under this description, we would have to question how UG could have become part of our biological endowment. A second and even more worrisome issue is that an extremely complex UG creates problems for language acquisition. UG is postulated to explain how the child can acquire language quickly and reliably on the basis of impoverished evidence. If

[154] The *locus classicus* of the P&P approach in found in Chomsky (1995).

acquisition requires that the child sift through a complex array of linguistic options provided by UG to find a match with the environmental evidence, the success of the enterprise becomes quasi-miraculous. The initial problem that the UG hypothesis was supposed to solve comes back with a vengeance. Thus, a successful solution to the problem of language acquisition imposes strict limits to UG's complexity.

P&P solves this tension by distinguishing between two kinds of computational primitives in UG: *principles* and *parameters*. Principles are language-invariant computational algorithms. Despite what casual observation indicates, human languages share deep and significant structural similarities at the level of syntax, morphology, phonology or semantics. The assumption, then, is that the child comes equipped with these language-invariant algorithms or principles. She does not have to discover them via induction on the linguistic evidence found in the environment since these are assumed from the very beginning. An example of a principle that is language-invariant is Principle C of Binding theory. Language acquisition studies (Crain and Lillo-Martin, 1999) and cross-linguistic research support the view that Principle C is a universal and non-configurable principle of UG. As such, the child acquiring language does not need to discover and learn Principle C.[155] All languages generated by UG respect Principle C no matter what linguistic evidence the child encounters during the acquisition period. Differences between languages are accounted for in terms of

[155] Whether Principle C is encoded in the human genetic endowment or is the end result of the interaction of genetic factors, informational factors and the 'third factor' is an empirical issue. It is also possible that Principle C can be reduced to simpler principles so that it does not need to figure in the theory of UG. Again, this is an empirical issue.

'parameter settings'. Certain principles possess configurable options or parameters. Depending on which option is selected, the internalized language will differ accordingly. One well-studied case is the 'head directionality' parameter (Baker, 2001). It is well known that certain languages are 'head first' while others 'head last'. In 'head first' languages, the head of the phrase occupies the phrase's leftmost position (e.g., English). In 'head last' languages, the head is found at the phrase's rightmost position (e.g., Japanese). Languages are consistently 'head first' or 'head last'. Based on these observations, the assumption is that UG contains a 'head principle' (i.e. 'all phrases must have a head') with a parameter (i.e., 'the head is either the first element of a phrase or the last). Language acquisition amounts to the setting of the various open parameters found in the principles of UG. The underlying assumption of P&P is that linguistic diversity (at least syntactic and phonological) can be accounted for in terms of a very limited set of parametric options.

Given P&P, language acquisition is to be understood as a succession of states of UG, which in turn can be described as the 'growth' of LO. At birth, UG is at its 'initial state'. Invariant principles are operational from the start and a number of parametric options require setting. Evidence suggests that parameters have default values at the initial state. If there is no evidence that justifies modifying the default or 'marked' parameter values, they will be part of the attained language. Once all parameters are set, LO attains its 'steady state', which defines the computational/linguistic competence internalized by the child after the process of language acquisition. The acquired language is simply the state of LO that is the result of the interaction of the innately defined initial state, UG, with the relevant linguistic evidence found in the environment. In recent works, the steady state is called *I-language*. I will explain why this label is used below.

Another innovation of the P&P model is the account of parameter setting offered. For the first time, there is a hypothesis that overcomes one of the most important weaknesses of the empiricist model. Recall that empiricists adopt the 'hypothesis constructing and testing' model of language acquisition. Given the observational and linguistic evidence found in the environment, the child elaborates a linguistic hypothesis and then sets out to test its soundness based on further environmental evidence. Hypotheses are supposed to be generated by using cognitive operations like association, similarity detection, abstraction, etc. I argued in Part 1 that this model is inadequate. Early work in biological rationalist linguistics still borrowed some elements from the 'hypothesis constructing and testing' paradigm, but there was nonetheless a crucial difference. Whereas the 'hypothesis space' is unlimited according to the empiricist hypothesis, biological rationalists argued that UG severely limits the 'hypothesis space' that needs to be considered. Thus, the child learning language only has to test a finite number of hypotheses and choose the one that offers the best fit with the evidence. This account went some way in fulfilling the explanatory adequacy condition stated above. However, there are obvious drawbacks to the 'hypothesis constructing and testing' model. For one, language acquisition seems to involve some deliberative process on the child's part. Yet, there is no evidence that such deliberation takes place. Instead, language acquisition appears to be automatic and does not require 'decisions' on the child's part.

The P&P model adopts a completely different approach: the *triggering model*. A parameter is not set following the confirmation of a tested hypothesis, but through direct causal interaction between the child's mind and the linguistic evidence in the environment. The presence of specific kinds of syntactic structures in the environment automatically triggers the setting of relevant parameters.[156] Take the example of the 'head directionality' parameter discussed above. One principle constitutive of UG determines that all linguistic phrases must have a head. When processing phrases from the primary linguistic evidence, UG detects the head component and its position. The 'head directionality' parameter is determined on the basis of the positional value detected by UG. Unlike the 'hypothesis constructing and testing' model, no deliberative procedure is required. Everything takes place autonomously within UG. Language acquisition is a completely opaque process from the child's standpoint.

The details of the triggering model still need to be fleshed out. For example, there is much controversy about which environmental factors are involved in the process. Some argue that semantic properties are triggers while others think that syntactic properties are (Gleitman, 1990; Pinker, 1984). It is quite reasonable to expect that UG relies on semantic, syntactic and maybe even phonological properties (i.e., prosody) for parameter setting. This controversy does not affect the triggering model itself and the claim that parameter setting is a causal phenomenon.

[156] 'Triggering' does not necessarily occur instantaneously; it can take place of over time. See Yang, 2003.

P&P forces us to reconsider the traditional account of language acquisition in terms of 'learning'. From a commonsense perspective, the child is described as 'learning' language. This is inaccurate. What is really happening is the automatic configuration of a computational organ on the basis of environmental data. UG is not really 'learning' anything per se; its parameters are being set causally. Furthermore, UG is not an intentional entity nor is UG's configuration an intentional process, which makes the use of 'learning' to describe the operation anomalous. The passage from the initial state to the steady state could even be described as involving a loss of knowledge. At the initial state, UG can potentially instantiate any human language. But once the acquisition process has run its course, LO has lost this linguistic pluri-potentiality. It has attained one configuration state, the steady state, which will remain largely unchanged throughout the speaker's life (all things being equal and with the exception of vocabulary growth and diminution, which is a different matter.)

As suggested earlier, a different way to approach the acquisition process that proves extremely enlightening is in terms of biological *maturation* or *growth*. Language acquisition is in fact the growth of the LO. The parallel between organic growth and language acquisition is startling when we examine the situation closely. The growth of an organ like the kidney is driven by internal constraints. Environmental conditions play a crucial but mostly supporting role; they do not determine the general structure and function of the organ. Barring serious deficiencies, the developmental path of the organ is pretty much determined. The same holds for LO. Its growth is strictly determined by internal constraints (i.e., principles) and the environment can only affect the maturation process in pre-determined ways (i.e., parameters).

The biological rationalist program is to be assessed on the basis of its theoretical and empirical accomplishments. Does it fare better than empiricist model? Does it meet the basic desiderata discussed in the first pages of Part 1? Does it deal more adequately with phenomena that proved especially problematic for empiricism? To the extent that the answer to these questions is positive, biological rationalism constitutes a better theory of language acquisition and it should be considered the default position until a better account is proposed. Below I offer a list of reasons why biological rationalism is indeed vastly superior to empiricism:

- The theory of UG provides an exhaustive description of the language acquisition device and how it operates. Baker (2001) and others are making headway in completing the inventory of principles and parameters. They are also proving that known human languages can be generated on the basis of this limited number of principles and parameters. UG does not rely on obscure capacities like abstraction, analogy, etc., but on parameter setting. Once parameters are identified, it becomes possible to specify the kind of information that must be available in the child's environment for language acquisition to occur. Here again, empirical data show that the evidence needed by the P&P model is available. In contrast, empiricism remains extremely vague with respect to the nature and features of the general learning mechanism involved in language acquisition. We encounter the same vagueness when it comes to specifying the evidence that is necessary and sufficient for successful language acquisition.

- Empiricism fails to meet the challenge posed by the poverty of stimulus observations. There is no adequate account of how the child can succeed in acquiring language in spite of the inherently ambiguous and incomplete nature of the primary linguistic evidence available. Matters become worse when we contemplate cases of language acquisition in atypical situations. Empiricism has nothing to say about phenomena such as Creoles, acquisition by perceptually impaired children, etc. The UG hypothesis accounts for all these phenomena. Acquisition can take place in poverty of stimulus conditions because the development of linguistic competence depends only marginally on environmental input. The core of linguistic competence is already internalized before the child starts parsing the primary linguistic evidence. For the same reason, variations, either in quality and quantity (within margins), of linguistic evidence have little impact on language acquisition. In the case of Creoles, we have natural languages that are the product of UG with most parameters set at the default or marked position (Bickerton, 1999). Perceptually impaired children acquire language with no apparent difficulties because the triggering evidence is formal (syntactic, semantic) and modality independent.
- It is a well-established fact that language acquisition takes place according to a strict timetable. Every child goes though the same acquisition milestones and acquires linguistic competence at roughly the same age.

The process is very rapid given the complexity of the competence acquired. Finally, language acquisition becomes difficult, if not impossible when it is a first language, after a certain stage in life. Empiricism has nothing serious to say about these phenomena. From the standpoint of biological rationalism this all makes sense. If language acquisition is literally the growth of an organ that is directed by biological constraints, then we expect children will go through the same stages at roughly the same time in their development given their shared biological endowment. The 'critical period' phenomenon is also witnessed in the case of the development of many biological mental systems (e.g., vision, some bird songs); what we encounter in language acquisition is analogous.

- Biological rationalism offers a principled account for the existence of linguistic universals. Whereas empiricists explain universals on the basis of putative environmental similarities or shared needs, biological rationalism accounts for the presence of universals in terms of LO's structure. Given the nature of these universals (i.e., abstract, complex, etc.) and the significant environmental variations, biological rationalism is a better explanation.
- The linguistic production of children acquiring language exhibits a number of features that are extremely puzzling from an empiricist standpoint. They overgeneralize rules despite the absence of evidence that would justify this. The kinds of 'errors' they produce are not entirely arbitrary or directly inferable from the primary linguistic evidence around them. Both phenomena have a clear explanation if we adopt biological rationalism. If

errors are constrained to a very narrow set of possibilities, it is because linguistic production is always the output of UG under some kind of parameter configuration, and there are only a finite number of parameter configurations. Overgeneralization can be explained in terms of interaction between the UG computational principles and the lexicon (Pinker, 1994).

- The kinds of 'errors' produced by children support biological rationalism. We reach the same conclusion when we consider the errors that children *do not make* when acquiring language. Research in the domain of 'negative facts' about language production (Pietroski, 2005) reveals that there are strict constraints on the interpretation children make of linguistic utterances. Perfectly rational interpretations are never considered. Biological rationalism offers the only way to make sense of these entirely 'arational' constraints; they are part of UG.
- Biological rationalism is supported by dissociation cases, while they undermine empiricism. If LO is a module, both biologically and computationally, then it is not surprising that linguistic competence can vary independently from other cognitive capacities. Especially, language acquisition is independent (to a large extent) of the cognitive capacities usually associated with intelligence (i.e., abstraction, analogy, etc.)
- Historical linguistic observations that indicate that diachronic transformations do not exhibit free variance but always converge on 'attractors' is more evidence in favor of the UG hypothesis. The 'attractors' are the various parameters settings that are available. Human

languages cannot vary freely because they are always one of the potential configurations allowed by UG.[157]

1.3 Language Organ and semantics

Universal Grammar is usually described as a hypothesis about syntax. The principles and parameters usually discussed (e.g., 'head parameter', 'null subject', etc.) reinforce this syntactic interpretation. If UG is strictly a syntactic developmental program, then it only offers a solution to the problem of acquisition of syntax in poverty of stimulus conditions. This leaves the acquisition of semantics unexplained.[158] In part 1, I argued that the acquisition of meanings takes place in just as severe conditions of poverty of stimulus as the acquisition of syntax. We cannot expect a child to acquire the kind of semantic competence exhibited by a fluent speaker if she can only rely on environmental evidence and domain general cognitive capacities.

Ancient and modern rationalists like Plato and Cudworth were keenly aware of the fact that concepts could not possibly be acquired via induction over environmental data. This convinced them that concepts must be innate and simply triggered by environmental conditions. Contemporary biological rationalists defend the same position. While the commitment to concept nativism might not always be explicit, it has been a central tenet of the research program since its beginning (Chomsky, 2000; 2002). The reason why syntax has been the focus of biological rationalists' efforts so far is essentially methodological.

[157] Lightfoot (1999) provides a thorough discussion of these questions. He introduces the notion of 'attractor' to make sense of the patterns in the diachronic transformations of natural languages.
[158] The acquisition of phonology also remains to be explained. Constraints on space prohibit discussion of this issue. See Kenstowicz (1994) for a biological rationalist account of phonology.

Syntax proved to be a more tractable problem and it offered better prospects for relatively rapid progress. Dealing with semantics, because of its complexity, was a problem to be tackled later. There was a hope that once a biological rationalist account of syntax had been put together, it might provide crucial information that could be used in the study of semantics. But from the very beginning, contemporary biological rationalists took for granted that a vast number of concepts need to be innate. There is simply no other choice given the poverty of stimulus observations and the creative aspect of language use (Chomsky, 2002).

Before going any further, it is necessary to clearly distinguish biological rationalism and empiricism on the issue of innate concepts. As pointed out in Part 1, empiricists are committed, whether they want it or not, to the existence of a stock of innate concepts. The child requires an unlearned conceptual toolkit in order to be able to operate the 'hypothesis constructing and testing' procedure by means of which the majority of concepts are supposed to be acquired. Empiricists insist, however, that the innate conceptual repertoire should be kept as small and simple as possible. Biological rationalists hold the bolder position that LO provides very rich innate conceptual resources.

The idea that our conceptual repertoire is largely innate has been greeted with extreme opposition. For a majority of philosophers, it is simply inconceivable that such rich conceptual resources can be biologically determined (Putnam, 1992; Churchland, 1986). Even philosophers that recognize, even if only begrudgingly (e.g., Davidson, 1997), that part of syntax must be innate simply reject semantic nativism. Davidson writes:

> What we are born with, or what emerge in the normal course of early childhood are constraints on syntax, not semantics. There is no reason to suppose that ideas are innate if this is taken to mean anything more than that people have come to have languages and thoughts that reflect the needs and interests of human animals. (1997, 21)

However, the position of opponents of biological rationalism is weak. As we saw in part 1, their proposal, empiricism, fails miserably to explain semantic acquisition. It provides no satisfactory account of how children acquire complex concepts quickly, effortlessly, and in a manner that is essentially impervious to the impoverished and fluctuating nature of semantic evidence. Furthermore, the few objections they oppose to concept nativism itself are unconvincing.

As of yet, there is no hypothesis about the 'conceptual acquisition device' of LO that is remotely as elaborated as the UG model we discussed. Biological rationalists have considered two different hypotheses in their attempt to elucidate the structure of the conceptual acquisition device. The first hypothesis holds that all lexical concepts –sub-sentential concepts like [dog], [brown], [cow]—are innate and atomic. For short, I will call this position *non-generative concept nativism*. It is 'non-generative' because lexical concepts are structureless entities (i.e., atoms) that are not produced by some generative *cum* computational process operating on more primitive conceptual units than lexical concepts themselves. Since lexical concepts cannot be 'built', they must already be fully individuated in the mind, and remain latent until triggered. This position is defended by Fodor *circa* 1981.[159] For the moment, I will leave aside the reasons motivating Fodor's position; these will be assessed when we will discuss semantic internalism below.

---

[159] Towards the end of 'The Present Status of the Innateness Controversy', Fodor considers a chemical model for concept creation, which is somewhat generative in nature. Fodor's

Generative concept nativism is the second approach to the question. Generative concept nativism claims that all concepts are built out of a finite set of innately specified conceptual features that are concatenated syntactically. Concepts are generated on demand when new cognitive tools are required by the subject to express thoughts and deal with her environment. This version of concept nativism does not entail that every concept is fully specified in the mind waiting to be triggered. Instead, it amounts to the claim that while all conceptual features are fully individuated in the mind and innate, concepts themselves are innate insofar as they are potential concatenations of innate conceptual features *and* that concepts are not learned but triggered.

To clarify the generative concept nativism hypothesis further, an analogy with phonology proves useful. Evidence supports the hypothesis that there is a finite set of phonological features that are used to generate phonological representations of linguistic expressions (Kenstowicz, 1994). Two languages, say French and Japanese, differ with respect to the phonological features they use. For example, French but not Japanese uses the phonological feature corresponding to the sound *R*. There are good reasons to think that innate constraints determine the set of phonological features that can be used in human languages and the principles of composition of these features. According to this view, the phonological representations of individual linguistic expressions (i.e., *cat* for [cat], etc.) are not innate. How could they be, given Sausurre's correct observation that sign/concept pairings are arbitrary? However, all possible

characterization of the model remains vague at best. He clearly distinguishes this model from a generative *cum* computational process for the elaboration of concepts. Since the publication this article, Fodor is usually read as defending the thesis I have described.

phonological representations are the product of the application of innate composition principles to an equally innate and finite set of phonological features. The claim being made by generative concept nativism is that a very similar picture is true for semantics.

Below I will flesh out generative concept nativism by considering how concepts are individuated within such a framework. When it comes to the question of semantic acquisition, the take-home message is that the child must bring to the table a rich conceptual endowment for the process to be successful. To paraphrase Chomsky (2000), the acquisition of lexical items must involve little more than assigning labels to concepts that are innately and internally available to the child. There might be some disagreement among biological rationalists about the exact nature of the conceptual endowment available to the child, but everyone agrees that there must be one and it needs to be substantial. From there, it is an empirical issue to determine the form that the conceptual endowment takes.

2 Internalism

Externalism holds that it is necessary to consider subject-external properties in order to achieve an adequate understanding of language. From this perspective, the function of language is defined in terms of communication. Language *qua* ontological entity is a practice that is socially and historically constituted. To know language is to possess a skill, the ability to act in a certain way. Finally, meaning is individuated by subject independent properties like features of the environment or social institutions. In Part 2, I argued that none of these views are adequate.

A different approach that can be adopted is the internalist perspective. From this theoretical standpoint, language is an independent system defined by organism-internal properties. The goal of an internalist approach is to describe these properties and, in the end, see how they help us understand language as a whole.

Internalism has not been popular among philosophers of language. The situation is quite different when we consider natural sciences. In fact, one could argue that the turn to internalism instigated by the likes of Galileo and Descartes is largely responsible for the phenomenal progress of our scientific knowledge. Galileo, Descartes and scientists after them realize that it is impossible to achieve a ‘theory of everything’, namely a theory that seeks to explain all phenomena at once using a unique theoretical apparatus. Science requires instead that we begin by isolating a real and tractable object of inquiry (i.e., a natural object); this is a task that demands a significant effort of abstraction in order to cut through unnecessary factors of complexity. This initial step is ‘idealization’. Afterwards, we try to understand the object inherent properties based on the data available. This process leads to the creation of a theory of the object under inquiry, which has its own theoretical concepts, constraints, methods, etc. The theory is limited in scope; it sheds light on the components, structure and operations (if applicable) of the object under analysis. This focus on building scientific theories that start from the object’s essential and inherent properties (i.e., ‘starting from inside’) is the fundamental characteristic of the internalist approach.

Current philosophy of language does not embrace the internalist methodology. First, there is no rigorous attempt to identify a real and tractable object of inquiry. As I argued in Part 2, E-language, the putative object that most philosophers of language 'study', cannot be defined coherently because E-language is not a genuine natural object. Second, the externalist approach to language is a kind of 'theory of everything', which explains why it fails to generate a cogent body of knowledge. Given how E-language is defined, a theory of this object amounts to a super-theory encompassing history (i.e., origin of linguistic conventions, causal historical theory of reference), sociology (i.e., language *qua* institution, division of linguistic labor), physics (i.e., precise account of reference), psychology (i.e., account of know-how, account of language use), and theory of communication. Making matters worse: there are good reasons to think that some of these phenomena do not support robust scientific theories. For example, it is doubtful that we can ever elaborate scientific theories of language use or human action (Chomsky, 2002). Both exhibit irreducible creativity and freedom that cannot be captured and explained using the concepts and methods of science.

Biological rationalists believe internalism is the correct methodological approach to study of language. As with all heuristic choices, its justification is to be found in whether it yields cogent explanations. What follows is an attempt to demonstrate that choosing internalism pays off. I will offer an internalist account of the four facets of language that we considered in Part 2 (i.e.,functional, ontological, epistemic and semantic). This time I will modify the order of presentation; I will start with the ontological and epistemic aspects, and conclude with the functional and semantic ones.

2.1 Ontological internalism

Much of the groundwork necessary for understanding the ontological internalist position has been laid down in the discussion of language acquisition. As a result, we will be able to proceed swiftly.

For biological rationalists, language *is* a biological *cum* computational organ. It is a faculty of the mind/brain. Only when considered from this perspective is language a natural object that warrants ontological recognition. The ontologically real properties of language are those that define it *qua* biological *cum* computational organ. These include UG's principles and parameters discussed previously; the lexicon, which is the set of lexical items at the disposal of the organ; and Merge, the computational operation that allows for the concatenation of lexical items to generate complex linguistic expressions. Excluded from language are peripheral systems like the articulatory-perceptual system(s) and the conceptual-intentional system(s). These systems are real but they are not part of the language organ *per se*. Language *interacts* with them in specific situations.

As we saw above, it proves useful to distinguish between various stages of LO's development. The theory of UG describes LO at its initial stage prior to language acquisition. The 'initial state' is an ontologically real state of LO. Once language acquisition has occurred, the parameters of UG have been set and the system has reached a 'steady state'. This state is called *I-language* and it is also ontologically real; it is a description of LO's intrinsic properties post-language acquisition.

The notion of I-language, which stands for an *internal*, *individual* and *intensional* language, is an attempt to make explicit the distinguishing features of language as it is understood by biological rationalists. Language is an *internal* structure of the human mind/brain. Language is *individual* because it is a component of a specific person's mind/brain. When we describe an I-language, we are describing the state of the language organ of a given individual. Above the level of I-language, we are dealing with abstractions (useful or not) but not real natural objects. Lastly, language is *intensional* because it is a generative procedure for syntactically individuated structures. These structures are not given in extension (i.e., they are not already individuated in the mind/brain), but in intension (i.e., by specifying, by means of a theory, the procedure to generate them).

Ontological internalism forces us to reconsider many pre-theoretical notions about language, many of which are deeply engrained in the philosophical tradition. For one, it does not make sense to talk of language as being a social artifact or an institution. Language might well contribute or even be a necessary condition for building certain human institutions, but it should not be confused with them. Accordingly, 'the English language' or 'the French Language' understood as public entities over and above speakers' I-languages are at best moderately useful idealizations but not real natural objects. It might prove heuristically worthwhile to abstract away from some differences between I-languages and focus on similarities. For example, it can be interesting to point out that speakers of a given community tend to share the same setting for the 'head directionality' parameter. However, this similarity in I-language configuration among members of a community does not justify positing the existence of an additional object, a common language, shared by all.[160] The principles governing language are not conventional in the usually understood way, namely they are not created and agreed upon by a group of speakers. Each I-language has its own set of principles that are constrained by the initial state of LO, UG, and is the product of the interaction between UG and the environment via parameter settings.

The benefits of moving from the E-language conception to the I-language conception are numerous. The study of E-language has generated no substantive theory of language over the years. By 'substantive', I mean a theory of language that succeeds in explaining the structure of human language, how it is acquired, etc. Parts 1 and 2 offer arguments and evidence supporting this harsh judgment. In contrast, once people turned their attention to I-language, there was serious progress in our understanding of language (i.e., contemporary generative linguistics). The vitality of the biological rationalist research program vindicates the ontology that it posits. And this is the normal order of things as Burge (1993) rightly points out.[161] Epistemic and heuristic considerations drive our ontology,

[160] It is interesting to point out that this argument is entirely uncontroversial in naturalistic disciplines. Consider the following example. Cytologists study cells. By studying individual cells, they make a number of generalizations like 'All cells have a nucleus' and others in the same vein. One thing they do not do, based on the generalizations they discover, is posit the existence of 'the Cell', which realizes all the shared properties of individual cells. At the end of the day, the complete inventory of the universe only contains individual cells. Now, it might be heuristically relevant to talk as if there was such a thing as 'the Cell', but this is nothing more than a kind of shorthand. It is unclear why the situation should be different in the case of language.
[161] Burge writes (1993): "…questions of ontology, reduction, and causation generally, are epistemically posterior to questions about the success of explanatory and descriptive practices. One cannot reasonably criticize a purported explanatory or descriptive practice primarily by appeal to some prior conception of what a 'good entity' is, or of what individuation or reference should be like, or of what the overall structure of science (or knowledge) should turn out to look like. Questions of what exits, how things are individuated, and what reduces to what, are questions that arise by reference to going explanatory and descriptive practices". Quoted in Chomsky, 1986, 250.

not the other way around. Externalists, however, put the cart before the horses. They put their commitment to a particular ontology of language as public object before epistemic and heuristic success.

Few among philosophers have been ready to embrace ontological internalism. The externalist notion of language still exercises too much attraction. At best, some philosophers have been ready to accept a two-tiered position. Basically, they recognize the existence of I-language and the relevance of a naturalistic study of this object, but insist nonetheless on the necessity of considering E-language in its own terms (e.g., Dummett, 1996). The latter is a different project; it is non-naturalistic and essentially philosophical and deals with language as grasped from the perspective of common sense. Both enterprises are to proceed along parallel paths. But the 'ecumenical proposition' rests on the assumption that the commonsense concept of language constitutes a worthwhile topic of philosophical, if not of scientific, inquiry. But this is questionable as we saw earlier.[162] The onus is on those defending the ecumenical proposition to provide a robust externalist research program. Until then, the proposition is empty.

2.2 Epistemic internalism

Externalists argue that knowledge of language is know-how. As we have seen, there are numerous and serious problems with this view. If knowledge of language is not know-how, then it must be know-that or propositional knowledge.

---

[162] It is worth pointing out that it is far from obvious that the commonsense understanding of language is in line with the concept of E-language as understood by philosophers. Chomsky (1986) offers an interesting analysis questioning this assumption. If this is correct, E-language might be nothing more than a theoretical concept introduced by philosophers. In this case, it should be judged strictly on its theoretical merits, which appear to be quite slim.

Yet, there are a number of properties of linguistic competence that are incompatible with those traditionally associated to propositional knowledge. For example, we know that someone can be linguistically competent and yet be unable to articulate the content of one's linguistic knowledge. However, it is widely believed that the possession of propositional knowledge entails being able to articulate this knowledge. Based on such observations, some argue that linguistic knowledge is in fact a *tacit* propositional knowledge. Linguistic knowledge is the internal representation of propositions, namely the principles and parameters of one's I-language. Samuels (2000, 17) writes:

> linguistic competence consist in the possession of an internally represented grammar of our natural language […] it is a domain-specific body of mentally represented knowledge or information that accounts for a cognitive capacity.

Fodor (2000) holds a similar position as the one advocated by Samuels.[163] The following story, or some close variant of it, is often put forward to explain why we cannot have access to linguistic knowledge. Linguistic knowledge is encapsulated within the language module. A property of cognitive modules is that their inner operations and representations are inaccessible to consciousness.

In a recent article, Collins (2003) claims that it is an error to view linguistic knowledge as a form of tacit propositional knowledge. I agree with him. Defending such a position indicates a fundamental misunderstanding of the nature of language *qua* natural object. Fodor and Samuels err because they misinterpret Chomsky's use of two fundamental notions: representation and knowledge. Unfortunately, Fodor and Samuels are not alone.

[163] See Collins, 2003, for textual evidence about Fodor's position.

When we examine some of Chomsky's statements, it is hard to see what is wrong with Fodor's and Samuels' interpretation. For example, Chomsky writes that:

> We can develop a concept of 'knowledge of language' that is appropriate for the inquiry into language and mind; namely, mastery and internal representation of a specific I-language. (2000, 73)

According to the widespread and *incorrect* interpretation of Chomsky's position, the previous statement should be cashed out as follows. Language L has a grammar G_L that consists in the set of propositions (i.e., principles and parameters) that describe this language. Jones knows L if and only if one of Jones' mental state, call it M, *represents* G_L. Thus, linguistic knowledge involves a kind of relationship between Jones' mental state and some object, a grammar, which is distinct from the representing mental state.

The idea that Chomsky's 'representation' represents something is a view that does not want to die. Despite Chomsky's numerous attempts to clarify the situation by explicitly stating that his concept of representation is a technical notion that differs from the one used by philosophers, the confusion prevails. In his recent paper *Representational Content and a Chomskyan Linguistics* (2003a and also 2003b), Georges Rey argues that, despite Chomsky's claims to the contrary, his representations must be *of* something. The gist of his argument boils down to this. I-languages are individuated by their principles and parameters, which are defined in terms of syntactic categories and features like NP, head position, etc. Whether individually or together, these individuating elements do not have the right properties to individuate computational processes. Thus, we can only have a computational model of an I-language if computationally tractable objects stand for or represent individuating linguistic properties of I-language.[164]

We can try to clarify his position by considering one of his examples. Linguistic competence involves phonological competence that can be described in terms of operations over phonological objects. For example, the following rule is part of English phonology (Fromkin, 2000, 555).

(1) /t/ => [+aspirated] / X ____ [+vowel & +stressed] (condition X cannot be /s/)

What the rule states is that /t/ will be realized as /'t^h/ whenever it is followed by a stressed vowel and is not preceded by /s/. According to Rey, such phonological rules *cum* operations do not describe computational operations, at least in the sense of Turing's notion of computation.[165] However, this does not mean that computational operations cannot realize phonological operations. They can if the 'formal objects' that computational operations process 'bear some systematic relation' with phonological features like 'phenomena in the oral cavity'. In other words, 'formal objects' in the computational operations must be systematically related to /t/, /s/, [+aspirated], [+vowel] and [+stressed], all of which are understood in terms of 'phenomena in the oral cavity'.

[164] To quote Rey (4): "the 'computations' (or 'derivation') of the various linguistic categories and features that are the heart of the theory need to be defined over mechanically identifiable formal objects, and the usual linguistic categories and 'features' (e.g., NP's, [+voice], [+PastTense]) cannot in general be expected to be objects of this sort. Consequently, in order for these categories and features to figure in the computations, they must be *represented* by some or other formal objects, and it is at that point that intentionality must therefore play a role in the theory".

[165] To be precise, I should say 'incompatible with Rey's interpretation of Turing's notion of computation'. It is debatable whether Rey's interpretation of Turing's position is accurate. Indeed, Rey seems to be reading quite a lot of his own views about computation into Turing.

Rey's use of phonology to illustrate his argument has one important benefit: it clearly reveals the utter incoherence of his position. Indeed, what are those phenomena in the oral cavity labeled /t/, /s/, [+aspirated], etc. that the formal objects are supposed to refer to? (Chomsky, 2000) Specific airflow modulations? Molecular motion? Operations of the speech apparatus (i.e., tongue movement and position, etc.)? But each of us realize /t/, /s/, [+aspirated], etc. in slightly different ways. As such, we cannot talk of /t/ as a natural object that is outside the head. Thus, it is moot to talk of 'reference' in this context. Rey could retort that he never implied that what formal objects refer to are outside the head of the speaker. In his article, he writes that he makes 'no claims about the character of a lingosemantics, nor even about whether representational content involves relations to phenomena in the external world'. So, it might be because a 'formal object' is systematically related to (i.e., refers to) an internal state that it can realize a phonological feature. This avenue does not appear to be very promising. First, this proposal cannot be evaluated unless he specifies the putative internal states that formal objects represent. For the sake of the argument, let's call these internal states "I_{Pfs}" for internal phonological features. Thus, the formal objects, call them FOs, represent I_{PFs}, and it is for this reason that computational operations over FOs can realize phonological generalizations like (1) that are stated in terms of /t/, /s/, [+aspirated], etc. I_{PFs} are individuated either internally or externally. If it is the latter, then we are back where we started; we need to know on the basis of which external properties I_{PFs} are individuated. But there are no plausible candidates available. If I_{PFs} are internally individuated, then why not dispense with FO and /t/, /s/, [+aspirated], etc. altogether and make our phonological generalizations in terms of I_{PFs}? In fact, one can wonder whether I_{PFs} are not the /t/, /s/, [+aspirated], etc. we started with.[166]

One could object that my last suggestion shows that I fail to appreciate the logic of Rey's argument. His point is that you cannot have a computational theory of phonology (or syntax, etc.) using the kind of categories and features used in phonology (or syntax, etc.) because they do not have the right kind of properties to be computationally tractable. To the extent that phonology (or syntax, etc.) is computationally realized, the computational operations must operate over computationally tractable formal objects that refer to phonological (or syntactic, etc.) categories and features. Until we can show that /t/, /s/, [+aspirated], etc. are computationally tractable (and Rey thinks they are not), Rey argues that his objection has not been meet.

But it is puzzling why Rey thinks that features like /t/, /s/, [+aspirated] are not computationally tractable. The only way to make sense of his view is to assume a misunderstanding on his part of the biological rationalist hypothesis. From the biological rationalist standpoint, what individuates features like /t/, /s/, [+aspirated], etc. are their computational properties. From the standpoint of LO, /t/ and /s/ are syntactically different (i.e., they are primitives). The set of computational algorithms that /t/ can be the input and/or the output of differs from the set of computational algorithms that /s/ can be the input and/or the output. The fact that /t/ and /s/ have the computational properties they do is not a function of their alleged intentional content, but it is a consequence of the intrinsic

[166] This argument is adapted from Chomsky's attack on Fodor's 'language of thought' hypothesis found in (2000).

computational properties of LO.[167] From the standpoint of the language faculty, /t/ and /s/ do not stand for 'phenomena in the oral cavity' or sounds. Operations on /t/ and /s/ will produce representations that will interface with the articulatory-perceptual system(s) and they will then *cause* certain 'phenomena in the oral cavity' that will generate sounds. The relationship between /t/ and the sound ultimately produced is not a representational one, but a strictly causal one.

In the biological rationalist idiom, "representation" means a syntactically individuated mental object. Individuation is a function of the features out of which the representation is built (e.g., /t/, /s/, [+aspirated], NP, VP, [+abstract], etc.). Assuming this technical definition of "representation", Chomsky's statement according to which

> [w]e can develop a concept of 'knowledge of language' that is appropriate for the inquiry into language and mind; namely, mastery and internal representation of a specific I-language. (2000, 73)

should be interpreted in the following way. Knowledge of language is not the representation in the speaker's mind of some external object (e.g., 'language' or a 'grammar').[168] To know a language is not to stand in relationship with something! When we say that "Jones knows English", this means that Jones' language organ is configured in a particular way, namely the way described by the theory of Jones' I-language. Thus, linguistic knowledge is really a biological *cum* computational concept. Linguistic knowledge is the internal state of the language organ. Thus, it is correct to say that 'The I-language is represented in the mind of the speaker' or that 'knowledge of language is to have a representation of an I-

[167] See Lasnik (2005) for an extended discussion of this issue.
[168] We must evacuate, as Collins (2003) correctly points out, all normative ideas according to which to know a language is have a representation that *accurately* captures some external object.

language' as long as 'representation' and 'knowledge' are understood internalistically, namely as description of LO's properties.

The way biological rationalists define "representation" and "knowledge" differs markedly from the standard philosophical interpretation. Some have criticized biological rationalists for not being sufficiently clear about this issue; the result has been unnecessary confusion. With respect to the 'representation' controversy, I think the fault rests squarely on the shoulders of the opponents of biological rationalism. Chomsky has been very clear that representation is a technical concept for him and he has been careful to specify what he means by it (*contra* Rey, 2003a and 2003b); he cannot be accused of confusion. If opponents of biological rationalism insist on reading "representation" as involving some kind of crypto-intentionality, there is little that can be done.[169]

When it comes to defining the nature of linguistic knowledge, the situation is more complex. While all biological rationalists reject the hypothesis that knowledge of language is know-how, not everyone agrees that it is propositional knowledge. It is true that Chomsky and others have sometimes talked of linguistic knowledge as being propositional. But for Collins (2003), this was essentially a rhetorical device that served to stress the fact that knowledge of language is not ability or a skill. It should not be interpreted as a commitment to the position that linguistic knowledge is a type of know-that as understood by philosophers

[169] Lasnik (2005) suggests that philosophers might be less confused if "representation" and "level of representation" were replaced respectively by "structure" and "level of structure".

Indeed, Chomsky (1986) has often argued that the philosophical dichotomy of know-how/know-that is not appropriate to capture the nature of linguistic knowledge. Know-how and know-that are commonsense concepts that are not suited to the naturalistic study of LO. He introduced the neologism 'to cognize' in order to circumvent what he considers a sterile debate. There are some benefits to not using the 'knowledge idiom' when describing language possession. It makes it easier to conceive language as a biological organ. It would be 'queer', in a Wittgensteinian sense, for someone to say 'I know how to see'. Vision is understood as biological system that develops autonomously and is governed by innate constraints that are beyond conscious control. Biological rationalists argue that language is in many respects similar to vision. Linguistic competence amounts to having the right kind of biological equipment with the right kind of configuration. Because linguistic competence is a cognitive competence, it is tempting to talk of 'linguistic knowledge', but this not very enlightening theoretically. And in fact, it seems to confuse some.

2.3 Functional internalism

I argued that the prevalent view among philosophers according to which the primary function of language is communication is inaccurate. Design, evolutionary and conceptual considerations support the rejection of this hypothesis. I proposed that natural language's primary function is to make it possible to produce certain types of complex thoughts. Because the function of language is defined in terms of what it provides to the subject's internal mental economy, I label this position *functional internalism*. The time has come to flesh out this view.

In order to make a convincing case for functional internalism, it is necessary to say more about the LO's operations. I mentioned above that LO generates internally individuated structured descriptions (henceforth, SD).[170] Each SD is built by concatenating lexical items (henceforth, LI) retrieved from the lexicon. A LI consists in a set of phonological and semantic properties. The phonological properties are labeled *I-sound*, while the semantic properties are called *I-meaning*. Thus, each lexical item can be described as an array consisting of two elements: {I-sound; I-meaning}. LO selects lexical items via a computational operation called *Select* and concatenates them via an operation called *Merge*. Merge takes two lexical items and combines them to generate a single syntactic object. Merge is recursive (i.e., the output of an instance of Merge can be fed into another instance of the Merge operation.) Hence, there is no limit (except those imposed by memory and processing constraints) on the length of the syntactic objects that Merge can generate. A third operation, *Internal Merge*, is used to reorganize features within a given syntactic object. According to the minimalist framework (Chomsky, 1996, chapter 3), each SD is expected to *converge* so that it meets the requirements set by two distinct interface levels: (1) the articulatory-perceptual level, and (2) the conceptual-intentional level. This means that by the end of the derivation process the SD will consist of two representations, *PHON* and *SEM*, that provide legible instructions to the

[170] Obviously, the language organ also interprets structured descriptions. This is how we come to understand what our interlocutors say to us. For simplicity's sake, my account will be in terms of production rather than interpretation.

articulatory-perceptual system(s) and the conceptual-intentional system(s). The former structure is responsible for the phonetic realization of linguistic expressions using a compatible modality (e.g., sound, gestures, etc.). The latter structure is related to people's beliefs and behaviors.

The separation of SD into PHON and SEM occurs at the *Spell-Out* stage. After Spell-Out, adding new lexical items with phonological representations to PHON or SEM results in a derivation crash.[171] From Spell-Out onward, PHON and SEM are derived in parallel and are subjected to different constraints set by the particular interface conditions they must meet. At the Pre-Spell-Out and post-Spell-out stages, derivation proceeds by a progressive *checking* (i.e., discarding) of the syntactic objects' properties until legible object are generated (unless a crash occurs.) It is at the level of checking that parametric settings play a role. Different languages impose different checking requirements that influence the legality requirements imposed by the interface levels on PHONs and SEMS. Chomsky (1996) illustrates this by examining the difference between French-style languages and English-style languages when it comes to verb raising. Consider sentences (2), (3) and (4) (from Ouhalla, 1999):

(2) John often kisses Mary.

(3) *John kisses often Mary

(4) Jean embrasse souvent Marie.

(3) is anomalous in English, while the French version, (4), is entirely idiomatic. In order for an SD to converge, it is necessary for all its constituting features to be

[171] The description I provide here is somewhat simplified. Some posit the existence of 'phases' and 'multiple spell-out', which makes the process more complex.

fully interpreted and checked. For verbs, this means that the V-features like Tense and Agreement must be interpreted (i.e., given a specific value) and checked at one point in the derivation. In the minimalist framework, the checking of V-features is done by raising of the V at the AGR and T nodes of the syntactic tree; the Internal Merge operation is responsible for the relocation of V. The difference between French-style and English-style languages has to do with the moment when the checking of V-features must take place. In English-style languages, V-features like T and AGR do not cause a crash if they are not checked by Spell-Out, and remain in the derivation of PHON. This is because they are 'weak' and they are invisible at the interface with the articulatory-perceptual system(s). The situation is different in French-style languages because V-features are 'strong'.[172] Thus, verb raising must occur before Spell-Out in French-style languages in order to check all V-features before the post-Spell-Out stage of the derivation of PHON. But the checking generates a new word ordering (i.e., raising of V) which influences the final phonological representation of the linguistic expression. The result is that the verb precedes the adverb as in (4). In English-style languages, verb raising does occur—this is necessary since SEM can converge only if all features are checked—but it takes place after Spell-Out within the derivation process leading to SEM. But since it happens after Spell-Out, this operation does not affect PHON, whose derivation is taking place independently from that of SEM. Hence, we get (2). But why is (3) anomalous then? Chomsky argues that whenever movement is not necessary for

[172] Chomsky offers a precise definition of the 'weak/strong' distinction in these terms: "a formal feature may or may not be strong, forcing overt movement that violates Procrastinate". I define Procrastinate below.

convergence, it should take place as late as possible, namely after Spell-Out. This is the *Procrastinate* principle. Notice that in the end, the SEMs associated to (2) and (4) will be essentially identical since raising will occur for (2) but it will be covert. This is an important finding and I will return to it below.

This is but the barest sketch of the computational process carried out by LO. It is sufficient for our purpose however. When we consider its design and its operations, the fundamental function of language *qua* biological *cum* computational organ is the production (and interpretation) of converging PHONs and SEMs using the resources of the lexicon. LO's task is to generate fully interpreted instructions destined to the articulatory-perceptual system(s) and the conceptual-intentional system(s). Still maintaining a strictly internalist methodological approach, it is possible to ask about the subsequent functions of PHONs and SEMs in the organism's mental economy. PHON's internal role limits itself to instructing the articulatory-perceptual system(s). The situation is more complex for SEMs. When LO generates SEMs, it creates complex conceptual structures. An organism lacking the language faculty, especially the Merge operation, cannot elaborate such structures. Its concepts remain isolated and the capacity to expand its conceptual repertoire using composition is nonexistent. But what distinguishes human cognitive capacities from that of other animals is precisely the capacity to generate complex and original thoughts by freely combining concepts with no apparent limits. And this is precisely what LO allows us to do by using Merge to concatenate lexical items and produce SEMs that meet interface constraints. Here is a simple example of the process at work. The language organ selects the following items form the lexicon: [bite], [boy],

[dog]. In order for interface conditions to be fulfilled, these lexical items must be concatenated in such a way that, among other things, theta-roles (agent role, patient role, etc.) are assigned. Thus, a converging SEM must indicate whether [boy] or [dog] is the agent of [bite] and who/what is the patient. The end result is a conceptual perspective (e.g., [boy bites dog] or [dog bites boy]) or a thought that is passed along to the conceptual-intentional system(s) and that can be used for a multitude of purposes like guiding action, interpretation, etc.

SEMs can plausibly be described as constituting at least part of the medium of complex thought. Hence, we can describe the LO's function in an organism's mental economy as enabling complex thinking. As I have repeated more then once in my discussion of functional externalism, I do not deny that language can be used for communication. But if I am correct, this function is secondary to the extent that it is a by-product of LO's more fundamental and internal role. LO *qua* enabler of complex thinking provides obvious advantages even in the absence of communication. If anything was selected for, it was not the capacity to communicate, but the capacity to entertain complex thoughts. It is because such thoughts can be generated in the first place that the distinctive communication practices of humans are possible at all. If it were not for the possibility of generating complex thoughts, human communication would be identical to animal communication: stimulus-dependent, non creative, etc.

The hypothesis that natural language is the medium of thought has been the object of extensive criticisms (e.g., Fodor, 1975; Pinker, 1994). The disagreement does not touch upon the hypothesis that complex thinking is made possible by a language-like medium. The nature of complex thoughts is such that it seems undeniable that they are built from basic components that are similar in properties to natural language's lexical items and structured in a way that mirrors natural language's syntax. Rather, the disagreement is on whether natural language *itself* is the medium of thought. A popular hypothesis (Fodor, 1975) is that in the human mind there is a *language of thought* (henceforth, LOT), which is distinct from human natural languages, that is the medium of thought. LOT is innate and arguably shared by all members of the human species. It has a finite lexicon and a finite number of recursive combinatorial principles allowing for the production of an infinite number of representations *cum* thoughts. Expressions of LOT are individuated on the basis of their syntactic properties. Thoughts are couched in LOT and then translated in the speaker's natural language. Language acquisition amounts to associating LOT expressions to their natural language counterparts.

One argument put forward to support the LOT hypothesis is what I call the *argument from ambiguity*. The crux of the argument is that natural language cannot individuate thoughts adequately because it is inherently ambiguous. Instances of syntactic ambiguity, synonymy and homonymy are offered to make this point. Consider the word "bank". In English, "bank" is homonymous and can mean (5), (6) or (7):

(5) a financial institution where one can deposit and withdraw money.

(6) an inclined plane.

(7) a row of similar objects.

Now, consider (8):

(8) The bank is red.

If thoughts are built using lexical items found in the lexicon of a natural language (in this case English), (8) is ambiguous. It can mean (9), (10) or (11):

(9) The financial institution where one can deposit and withdraw money is red.

(10) The inclined plane is red.

(11) The row of similar objects is red.

But this is unacceptable. Our thoughts have determinate contents. When I think (9), there is no ambiguity with (10) or (11) *in my mind*. If there is no ambiguity, then it means it cannot be represented *in my mind* as (8) since (8) is ambiguous. Put differently: we expect the medium in which our thoughts are couched to permit their full individuation on the basis of their intrinsic components and structure. But if natural language is the medium of thoughts, this basic requirement is not met, the argument goes. Different thoughts can be represented by the same natural language expression.

Synonymy is believed to raise a similar problem. Consider the following sentences:

(12) I closed the door.

(13) The door was closed by me.

Arguably, (12) and (13) express the same thought. However, (12) and (13) are different expressions from the perspective of natural language. They do not share the same structure or the same components. Again, natural language is said to fail to individuate thoughts properly. The conclusion is that the medium of thought cannot be natural language; it must be a fully disambiguated language of thought.

The *argument from ambiguity* does not constitute a serious objection. The only way the argument can get off the ground is by assuming that the lexicon is extremely impoverished in addition to presuming that individuation is a function of orthographic properties. According to the minimalist model, each lexical item is an array consisting of two components: I-sound and I-meaning. Two lexical items are identical if and only if they share the same I-sound and I-meaning. Thus, lexical items that share either the same I-sound or I-meaning are different lexical items from the LO's standpoint. Take "bank" as an example. In the lexicon, we find three entries sharing the same I-sound *bank*. However, each entry has a unique I-meaning. We can imagine that the lexicon would look something like this:

…
[$bank_1$]: I-sound = *bank*;
I-meaning = a financial institution where one can deposit and withdraw money.
[$bank_2$]: I-sound = *bank*;
I-meaning = an inclined plane
[$bank_3$]: I-sound = *bank*;
I-meaning = a row of similar objects.
…

When LO selects a lexical item, it chooses between [$bank_1$], [$bank_2$] or [$bank_3$]. SEMs generated will differ depending on whether [$bank_1$], [$bank_2$] or [$bank_3$] is initially selected. Hence, (9), (10) and (11) are individuated by different SEMs. Ambiguity is avoided without positing a LOT.

What about syntactic ambiguity? Sentence (14) is ambiguous since it can be understood as meaning either (15) or (16):[173]

(14) I shot the elephant in my pajamas.

[173] (14) is famous pun by Groucho Marx that has become a staple example of syntactic ambiguity in linguistics.

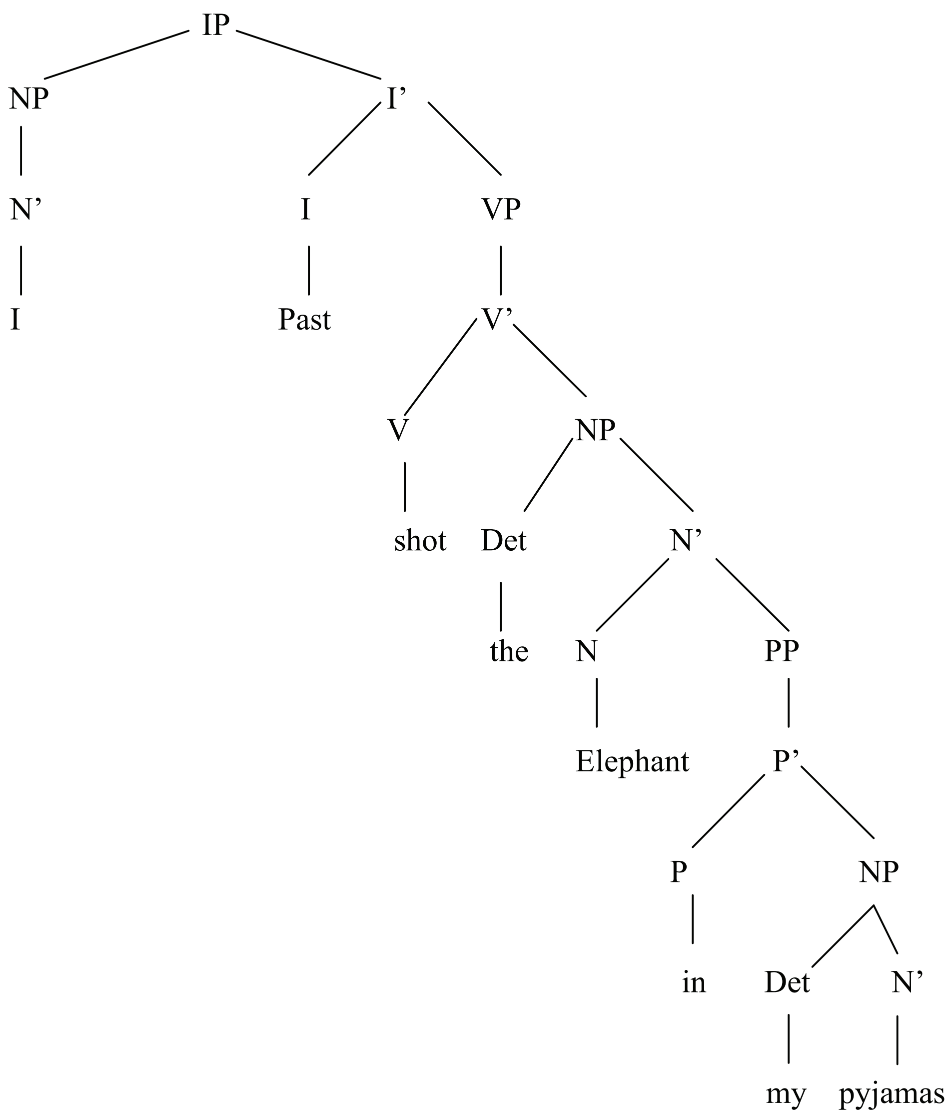
(15) I shot the elephant while I was wearing my pajamas.

(16) I shot the elephant that was located in my pajamas.

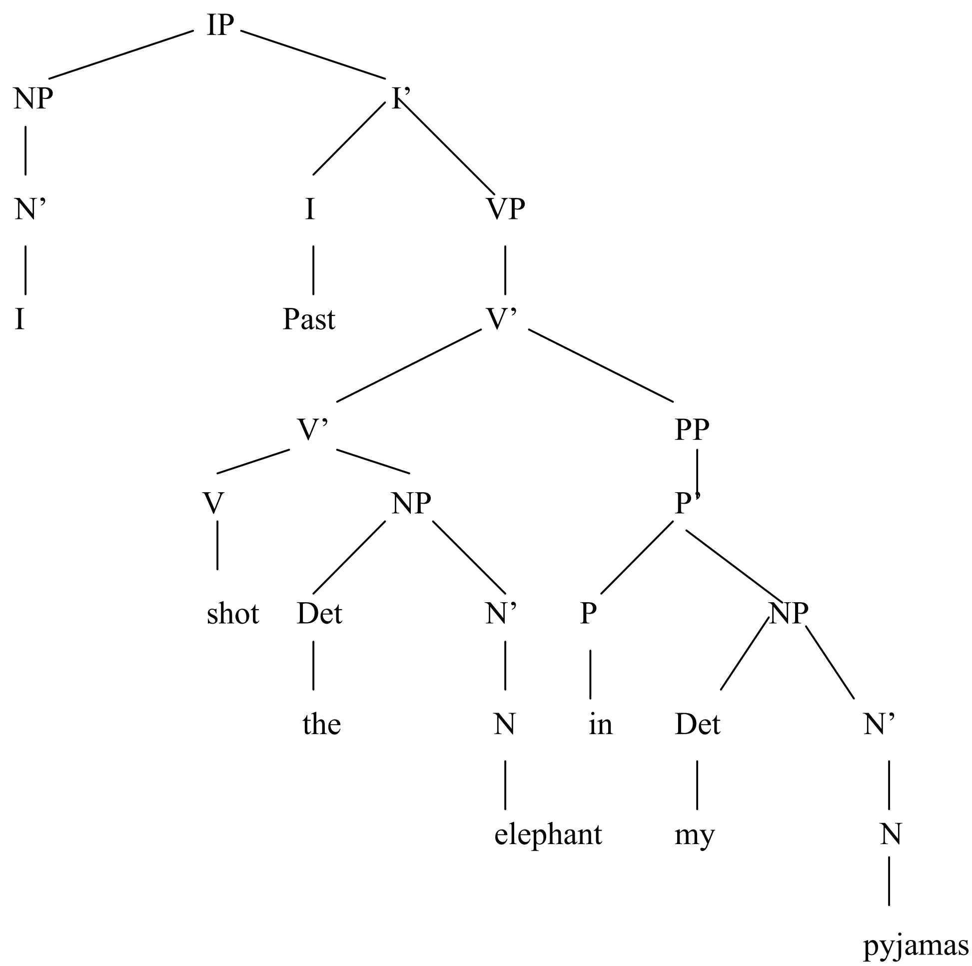
(17) I shot the elephant that was wearing my pajamas

In this case, it is unlikely that the lexical considerations will be sufficient to eliminate the ambiguity. Notice, however, that (14) is ambiguous only if we limit ourselves to 'orthographic features'. However, SEMs are not individuated on the basis of orthographic features alone. Syntactic features are also present in SEMs and serve to individuate them. Focusing on the difference between (15) and (16), their SEMs will share the same lexical items but they will differ structurally. (18) and (19) illustrates the extent of their structural differences:

(18) I shot the elephant located in my pyjamas.



(19) I shot the elephant while wearing my pyjamas.



In sum, if LO produces SEMs as defined above, the problem of ambiguity does not arise.

If thinking is possible in absence of natural language, then the hypothesis that language is the medium of thought cannot be right. This is the *argument from dissociation*. Advocates of LOT believe there is plenty of evidence for the dissociation of natural language competence and thinking. For example, they mention the case of people suffering from serious linguistic impairments (e.g., SLI) who do no exhibit noticeable thinking deficiencies. Individuals who never acquired a natural language because of neglect (e.g., Genie, Curtiss, 1977) or absence of exposure to appropriate linguistic evidence (e.g., children deemed deficient, deaf-mute children) but who show obvious thinking capacities can be considered to be additional evidence showing that linguistic competence and thinking can be dissociated. The same can be said of young infants and some animals that have obvious cognitive capacities that fall under the label of 'thinking' and yet have no access to a natural language. Finally, there is evidence from introspection. The fact that we are sometimes unable to put our thoughts into words seems to indicate the medium of thought is not natural language.

It is possible to account for all these facts while maintaining that LO is the engine of complex thinking. First, it is important to recall that my claim is not that all thinking requires the machinery and operations provided by LO (e.g., lexicon, Merge, etc.), but only complex thinking does. It should be clear to everyone that there is a significant difference in the thinking capacities of animals, infants and adults. While animals and infants can be said to 'think', they do not produce the kind of complex thought patterns characteristic of adult cognition. If the position I defend is correct, this state of affairs can be easily explained: animals lack the language organ and it is not fully developed in the case of infants. Hence, reference to animals' and infants' cognitive capacities does not undermine my hypothesis. To refute it, one must show that the kind of complex thoughts that adults produce can be generated in the absence of a functional language organ.

Proponents of LOT are right when they claim that people with linguistic impairments like SLI can exhibit normal thinking capacities.[174] However, this does not invalidate my hypothesis or prove the existence of LOT. We must keep in mind that impairments can affect aspects of LO selectively with the result that some computational processes can still operate flawlessly. If we consider SLI, there are good reasons to believe that the impairment affects only peripheral computational operations (e.g., certain aspects of the inflection module, see Gopnik, M., Dalalakis, J., Fukuda, S. E. & Fukuda, S., 1997, Gopnik, M. & Crago, M. B., 1991, and Pinker, 1994). Merge and other processes are still fully operational enabling the production of SEMs and normal thinking capacities. Similarly, impairments that involve the derivation of PHONs without affecting the derivation of SEMs will have little effect on thinking even if they lead to significant conversational disruption.

Adults who have not acquired the mastery of a natural language offer the best case study for proponents of the LOT hypothesis. Despite what is sometimes said, individuals like Genie, who have substantial linguistic deficiencies due to a dearth of linguistic input during the critical period of language acquisition, do exhibit serious cognitive deficiencies affecting their capacity to entertain complex thoughts (Curtiss, 1977). This is anecdotal evidence that without a normally functioning LO complex thinking is impaired.[175] Pinker (1994) discusses the case of a deaf and mute individual, Ildefonso, who despite having acquired no natural

---

[174] Many articles in Gopnik, M. (ed.) (1997) provide evidence supporting this claim.

[175] It is possible that the psychological trauma caused by the severe neglect children like Genie endured is responsible for the cognitive impairments encountered. This is why I talk of 'anecdotal evidence' here.

language displays clear signs of complex thinking. At first glance, this case seems to confirm the LOT hypothesis. Yet, a different interpretation is possible. The growth of the language organ is known to exhibit extraordinary resilience even in extreme conditions. Recall how children exposed to Pidgin literally invent Creole despite the extremely impoverished nature of the linguistic evidence at their disposal. In the case of Ildefonso, we can imagine that his language organ developed normally even if it did not converge towards a language that can be externalized (i.e., no PHONs are associated to SEMs). The innate syntactic and semantic resources that come automatically from LO's normal growth (i.e., innate concepts, Merge, etc.) are available to him and allow him to generate complex thoughts. In a way, cases like Ildefonso illustrate the most fundamental role played by language, the one that probably explains why language was selected for when the possibility for communication were essentially null: namely that of enabling thinking at a higher level of complexity. Even if Ildefonso does not use his LO to communicate linguistically, the computational resources that the organ provides are used to their fullest potential *internally*.

The 'tip of the tongue' phenomenon (henceforth, TOT) can be accounted for without assuming LOT. For example, TOT might occur in the unusual event where the SEM derivation converges but not the PHON derivation. The conceptual-intentional system(s) receives fully interpreted instructions generating a thought, but the LO fails to generate an interface representation that can be interpreted by the articulatory-perceptual system(s). The result is that there is a thought (i.e. a SEM) generated but it is not phonetically realized (i.e., no PHON). TOT might also be the consequence of a crash resulting from errors in the interpretation or realization of a valid PHON by the articulatory-perceptual system(s).

LOT's advocates also invoke a different kind of dissociation to defend their hypothesis. In Part 1, I discussed the particular cognitive symptoms associated with Williams syndrome. People affected by this condition exhibit impressive linguistic competence but have serious cognitive impairments. From this, it seems to follow that a fully operational language organ does not guarantee full thinking capacities. Furthermore, it appears that thoughts are not reducible to SEMs. The challenge posed by Williams syndrome to the hypothesis I defend is serious, but it can be defused. SEMs are syntactic objects that interface with the conceptual-intentional system(s). What the conceptual-intentional system(s) provides to the mental economy is the means to incorporate SEMs in the particular network of intentional states (e.g., personal beliefs, desires, folk knowledge, social knowledge, environmental knowledge, etc.) of each individual. If the conceptual-intentional system(s) is impaired or if the interface between SEM and the conceptual-intentional system(s) is inadequate, the cognitive capacities will be affected and thinking will deviate from the norm. This is precisely the case of Williams syndrome. Individuals with this condition are able to generate complex thoughts, but these are odd from an intentional standpoint. For instance, thoughts produced are sometimes mutually inconsistent. They fail to correspond to reality or are coherent from the standpoint of an abnormal conception of reality. In other words, Williams syndrome individuals generate syntactically and semantically well-formed thoughts but these enter into an economy of intentional states that is seriously skewed, which results in the peculiar cognitive symptoms associated with this genetic condition.

The last line of reasoning in favor of LOT I want to examine is the *anti-relativism argument*. If we think using natural language, then people using different natural languages will 'think differently' because each natural language has its own concepts and syntactic structure. Hence, it seems that we are forced to accept the Whorfian hypothesis that different linguistic populations are cognitively incommensurable. It becomes impossible to understand the psychology and the worldview of individuals speaking natural languages different from ours. We cannot rely on translation to bridge the gap because it always involves a significant loss of information. The problem with this kind of cognitive incommensurability thesis is that it does not hold up to observation. Despite all the linguistic and cultural diversity we observe, ethnoscience shows that there is a great deal of cognitive uniformity among humans. Pretty much all share the same commonsense framework (i.e., folk physics, folk psychology, folk biology, religion; see Atran, 1990 and 2004). When we encounter differences, they are usually superficial and can easily be overcome. Humans have the capacity to understand each other even if they have very different linguistic backgrounds. These observations are easily accounted for if humans share a common LOT and natural languages are simply 'window dressing' for it.

The biological rationalist position I advocate does not commit us to the Whorfian-style incommensurability thesis. Evidence suggests that different I-languages generate basically very similar SEMs (Chomsky, 1996). That this is the case should not be surprising. Because of the very strict biological constraints on LO's development, different I-languages share the same basic architecture (i.e., principles with only limited parametric variations). They are all possible states of a unique biological *cum* computational system. I-languages mostly diverge with respect to phonetic representations and surface effects (e.g., whether wh-words are moved or remain *in-situ*) that play no role in generating SEMs.[176] We know that SEMs must meet interface conditions set by the conceptual-intentional system(s) if crashes are to be avoided. We can assume that the interface conditions are the same whatever I-language is realized by the language organ. Supporting this hypothesis is the fact that the development of the conceptual-intentional system(s), as is the case for the articulatory-perceptual system(s), appears to be largely autonomous from the development of LO (Hauser, Chomsky, Fitch, 2002). As a result, all possible I-languages must end up generating SEMs that are largely similar because of the interface conditions. Furthermore, the building blocks out of which SEMs are built, namely the I-meaning component of lexical items, are most likely very similar across the human species. As we saw, poverty of stimulus observations leave no choice but to conclude that conceptual resources are innately determined. Thus, LO can play a central role in the production of thoughts without cognitive incommensurability being a consequence.

None of the arguments supposed to prove that natural language cannot be the medium of thought are very convincing. Now, I want to examine a reason

[176] Chomsky writes (1996, 192): "We expect languages to be very similar at the LF [SEM in the new terminology], differing only as a reflex of properties detectable at PF; the reasons basically reduce to considerations of learnability. Thus, we expect that at the LF level there will be no relevant difference between languages with phrases overtly raised or in situ (e.g., wh-phrases or verbs)".

why the natural language as medium of thought hypothesis is in fact preferable to the LOT hypothesis. When asked to choose between two hypotheses that 'save the phenomena' equally well, theoretical and ontological parsimony can be used as criteria to decide between the candidates. On both counts, the performance of the LOT hypothesis is well below that of the natural language hypothesis (Chomsky, 2000). The LOT hypothesis posits the existence of an additional level of mental representations with its own syntax and semantics over and above natural language.[177] How these two levels interact must be clarified, which is far from a trivial issue. For example, how do natural language expressions relate to expressions of LOT? The assumption is that a natural language expression contains a pointer that refers to its counterpart in LOT. But in virtue of what does a pointer refer to the right concept of LOT? To explain this we need to introduce more machinery, which makes the model increasingly complex. By explaining thinking in terms of SEMs understood as instructions to the conceptual-intentional system(s), we are able to provide an explanation that is simpler both ontologically and theoretically.

2.4 Semantic internalism

Semantic internalism is the view that meaning is fully individuated by organism-internal properties. Put differently: it is possible to fully capture the meaning of a linguistic expression without having to take into account subject-

[177] Fodor (1998, 9) emphatically claims that 'English *has no semantics*'. The same conclusion holds for all natural languages. Only LOT has a semantics. But as Pietroski (2000) argues, Fodor's assertion is not very credible without additional work on his part. For one, he must explain why natural language semantics currently available are successful. This success cannot simply be a matter of luck. It is not sufficient to say that natural language semantics work because they somehow map the LOT semantics unless he provides a reasonably worked out semantics for LOT and some independent evidence for the existence of LOT. Independent evidence for LOT has been shown above to be quite weak, and there is still no serious LOT semantics.

external properties. It should be obvious that an internalist theory of meaning will differ strikingly from an externalist theory of meaning. Semantic externalists seek to determine the subject-external properties that enter into the meaning of expressions. As such, they focus on reference, use, conventions, truth conditions, which are all cashed out in terms of properties found 'outside the head' of the speaker. Semantic internalists aim to describe the internal semantic states of LO. To use minimalist terminology, the goal is to construct a theory of I-meaning and SEM. A satisfactory theory will explain the means of production of I-meanings and SEMs, their respective structure, their basic constituents, and their roles. Some of the things that were discussed in the section on functional internalism already shed some light on the nature of SEMs. They are structured entities consisting of legible instructions for the conceptual-intentional system(s) that are derived from SDs, which are themselves structures built out of lexical items. The I-language realized by LO determines what SEMs can be generated. Since an I-language is one of the possible configurations of UG, there are innate constraints on what SEMs humans can possibly produce. A lot more could be said about SEMs, and a lot more needs to be discovered about them. This general account of SEM will be sufficient, however, for my purpose. Leaving SEMs behind, I want to turn my attention to I-meanings.

The working assumption adopted by biological rationalists working within the minimalist program is that each lexical item is an array consisting of a phonological component, an I-sound, and a semantic component, an I-meaning. Biological rationalists all agree that I-sound and I-meaning are innately constrained and internally individuated. However, there is some controversy about how I-meanings are internally individuated. As mentioned above, there are two proposals on the table: the non-generative atomistic hypothesis and the generative hypothesis. Proponents of the former contend that I-meanings are structureless atoms. The semantic value of an I-meaning is not conferred by more primitive semantic features. Hence, I-meanings make up the semantic primitives of LO. Advocates of the generative hypothesis hold that it is possible to analyze I-meanings into more basic semantic features. The semantic value of an I-meaning is a function of the semantic features that constitute it and of their organization. LO's semantic primitives are not, therefore, I-meanings, but sub-root semantic features.

The case in favor of the atomistic conception of I-meaning rests essentially on the demonstration that the generative account is untenable. Fodor, who until recently promoted atomistic semantic nativism (1981), thinks there are two major flaws with the generative hypothesis.

If the generative hypothesis is correct, the semantic value of an I-meaning is determined by the sub-root semantic features that enter into its composition and their organization. Fodor interprets this statement in the following way: for each I-meaning we can construct a *definition* consisting of sub-root semantic features that captures its semantic value. The problem, according to Fodor, is that, despite years of effort, satisfactory definitions are in very short supply (Fodor, J. A., Garrett, M. F., Walker, E. C. T. & Parkes, C. H. 1980). Even for lexical items that seem semantically quite simple, definitions prove elusive. Whenever someone claims to have discovered a statement that captures the necessary and sufficient semantic features of a given linguistic expression, counter-examples follow shortly. Fodor and Lepore (1992, 1998) have become experts at debunking definition proposals. For Fodor *et al.*, these difficulties count against the generative approach and favor the atomistic hypothesis.

More recently, Fodor (1998) identifies another problem with the generative position. The nature of this argument illustrates how Fodor's conception of semantics has changed since his adoption of 'informational semantics'. The argument runs like this. It is all well and good to account for the semantic value of I-meanings in terms of semantic features, but then one must explain how the semantic features themselves get their semantic value. According to Fodor, most advocates of the generative hypothesis simply beg the question when faced with this issue. The usual strategy consists in fudging the distinction between object language and meta-language. Because the labels used to identify sub-root semantic features, which are part of the theoretical meta-language, are often homonymous with expressions of the object language, it makes it easy, but no less illegitimate, to assign the semantic value of object language expressions to the homonymous semantic features. But this begs the question since sub-root semantic features are supposed to supply the semantic value in the first place. To illustrate this problem, consider one sub-root semantic feature that is often discussed: [+artifact]. This feature is said to provide I-meanings with a specific semantic component, namely the concept of [artifact]. When asked to specify the semantic value of [artifact], there is an implicit reference to the lexical item "artifact", which is borrowed from object language. [Artifact] *qua* sub-root semantic feature means *roughly* what "artifact" *qua* lexical item means. But since the I-meaning of “artifact” *qua* lexical item presumably gets individualized in part by the semantic feature [+artifact], this is a circular definition.

What is interesting with this last argument is that it not only undermines the generative hypothesis, but also the atomistic concept nativism that Fodor used to defend before his change of heart.[178] Indeed, this argument is essentially an attack on semantic internalism, which is assumed by both the generative and non-generative nativist positions. For Fodor, one cannot simply take [+artifact] as a primitive without providing some kind of explanation for the source of its semantic value. But notice that the same demand can be made to the proponents of the atomist hypothesis; one cannot argue that I-meanings are semantic primitives without providing an explanation for the source of their semantic value. Such considerations have led Fodor to adopt informational semantics in his more recent work (1998). Informational semantics is an externalist position; the meaning of an expression is determined by the subject-external properties that reliably cause the expression’s tokening. The rejection of internalism leads Fodor to modify his position towards biological rationalism. Circa 1981, Fodor thought concepts were thoroughly innate. Today (1998), he distances himself from this view. Instead, he argues that our innate endowment consists in the mechanisms that are causally responsible for locking onto properties of the world. Properties of the world constitute the semantics of concepts, while the mental representations that are causally linked to environmental properties—what Fodor calls MOPs or modes of presentation— are generated by the innate mechanisms.

[178] It is true that Fodor has never been a strict semantic internalist. The notion of ‘wide content’ plays a role in his philosophy even before his adoption of informational semantics.

Thus, Fodor's second objection cannot be used to decide between the atomist and the generative semantic internalism hypotheses. It poses a challenge that must be met by all semantic internalists. I believe it is possible to deal with Fodor's objection if we adopt the generative standpoint. Generative nativists, like all biological rationalists, hold that sub-root semantic features and I-meanings are ultimately biological objects with biological properties. Why certain sub-root features, when they are concatenated into certain I-meanings, cause LO to enter in a specific semantic state is in the end a function of both LO's biophysical properties and of the sub-root features. It is a brute and contingent fact about human biology that the sub-root semantic features cause the kind of internal biological *cum* semantic states that they do. When the SEM [The dog is under table] is generated by composition of I-meanings generated by the concatenation of sub-root semantic features, what is produced is the [the-dog-is-under-the-table] kind of thought. That this particular SEM is this particular thought does not need to be explained in terms of the SEM, I-meanings or sub-root features standing in some relationship with subject-external properties that confer them semantic properties. Rather, the SEM's semantic properties are a function of the I-meanings constituting it, while the I-meanings' semantic properties are a function of the sub-root semantic features constituting it. Sub-root semantic features are primitives and their semantic properties are a brute biological fact.

An analogy with vision might help make my point clearer. A visual experience is the consequence of the stimulation of visual system cells. To simplify things to the extreme, assume that when certain retinal cells XYZ are stimulated in a particular way, the result is the visual experience of a line. Here, we take it for granted that the explanation for why the stimulation of retinal cells XYZ amounts to this specific kind of experience is ultimately biological. It is because of (1) the visual system's inherent biological properties and (2) the causal effect of the stimulation of retinal cells XYZ on the visual system that the experience of a line, but not another kind of experience (e.g., circle-experience), arises. More generally: we accept as brute biological facts that certain states of the visual system generate certain visual experiences and not others. To seek justifications for these brute and contingent biological facts is a hopeless endeavor. At one point, it is necessary to stop asking 'Why?' and accept the existence of primitive biological facts. This is a necessary step in order to bootstrap the process of naturalistic explanation. Obviously, the ontology of primitives mental-biological features, whether in vision science or semantics, is not to be decided by fiat, but must answer both empirical and heuristic constraints. We will return to this issue shortly.

Once we adopt the view that sub-root semantic features are primitives and that their semantic properties are a brute biological fact, we can deal with Fodor's accusation that the generative hypothesis is begging the question by confusing object language and meta-language. For the sake of the argument, assume that [+artifact] is a primitive sub-root semantic feature that can enter in the composition of I-meanings. We can find this semantic feature in the I-meaning of lexical items like "car", "scissors", "chair", etc. and, obviously, "artifact". Within the generative theoretical framework "[+artifact]" is a meta-language label that refers to a specific semantic feature *cum* biological entity, namely [+artifact], that is exemplified by lexical items listed. What is at work here is called by

McGilvray (1998) *sophisticated autoexemplification*. An object language expression (i.e., artifact) which generates a specific kind of semantic property is transformed into a theoretical term (i.e., "[+artifact]") that refers to a semantic feature *cum* biological entity. Whether or not [+artifact] is a legitimate feature is an entirely empirical question to be decided by the usual criteria used in empirical sciences.

Having dealt with Fodor's second objection, let's focus on the first. Is it legitimate to interpret the dearth of definitions as evidence against the view that I-meanings are structured entities built out of sub-root semantic features? Does this same evidence support atomism? I do not believe so. From the fact that I-meanings have no definitions in the standard sense, we cannot conclude that they have no parts at all. They could have parts that contribute their respective semantic properties, but which do not jointly constitute definitions, understood as statements of necessary and sufficient conditions of application or use. For example, the idea that there can be structured meanings without definitions is at the core of the prototype theory of meaning. According to this account, a lexical item's meaning is the set of features that are reliably (but not necessarily) exhibited by what it refers to. Obviously, the prototype theory is incompatible with the internalist approach since meaning is individualized using subject-external properties.

There is a way, however, to cash out the idea that I-meanings are structured entities made up of parts, and yet have no definitions in the standard sense, that is consistent with the internalist standpoint. In his recent work, Chomsky (2000) (see also McGilvray (1998) for an attempt to flesh out this notion) suggests that I-meanings (and SEMs) are best understood as internal 'perspectives'. I-meanings provide the speaker with the possibility to entertain various kinds of thoughts and to apprehend the world from distinct 'cognitive angles'. For instance, the I-meaning [book] makes it possible for the speaker to produce book-thoughts and to interact with the world from a 'book viewpoint'. The kind of perspective made available by the I-meaning [book] is determined by the sub-root semantic features constituting it and their organization. It is in part because it contains the sub-root semantic feature [+artifact] that [book] endows the speaker with the particular perspective it does. The sub-root semantics features that enter into the composition of a given I-meaning do not amount to a definition if one means by 'definition' a statement of necessary and sufficient conditions of application or use. What sub-root semantic features specify are the basic characteristics of the perspective realized by a given I-meaning. The perspective is inherently open-ended when it comes to conditions of use, and this is what makes creative use possible in the first place.

While the sum of sub-root features constituting an I-meaning do not amount to a definition in the standard sense, they do from a different perspective. The standard notion of definition is an externalist concept; it is an attempt to capture use in a community. If we adopt the internalist perspective in the study of language, it makes sense to talk of a different kind of 'definition'. From the internalist standpoint, a definition is a representation that captures the essential semantic features of an I-meaning *from the perspective of the language organ*. In other words, an internalist definition is a theoretical specification of the set of features that will play a role in how an I-meaning will contribute to the derivation of SEMs. Internalist definitions will share few commonalities with their externalist counterparts. The former will be couched in technical concepts that refer to the real properties of LO as biological *cum* computational structure. Unlike the externalist concept of definition, the internalist one can be specified with precision. Because I-meanings enter into the derivation generating SEMs, the derivational algorithms impose limits on the formers' structure. Once we understand the derivational algorithms yielding SEMs, we will know the necessary attributes and structure that I-meanings must have, which amounts to a formal specification of the concept of I-meaning definition.

In his work (1995, 2001, see also Moravcsik, 1975), Pustejovsky offers the most elaborate proposal about the structure of I-meaning. He argues that an I-meaning is constituted of four structural units: (1) argument structure, (2) event structure, (3) qualia structure, and (4) lexical structure. For our purpose, the three first types of structure prove to be the most relevant. The 'argument structure' (a theoretical notion in his account) specifies the number and the types of arguments inherent to the structure of an I-meaning. The 'event structure' defines the event type, if applicable, of an I-meaning. The 'qualia structure' specifies an I-meaning's Aristotelian modalities, namely (1) what it is made of (constitutive), (2) what it is (formal), (3) its function (telic), and (4) how it came into being (agentive). Here is a simplified example of what an I-meaning's structural description or definition would look like (adapted from Pustejovsky, 1995, 2001):

[Book]

Argument structure= Arg1= x: [+information]
Arg2= y: [+artifact]

Arg3= z: [+rational agent]

Qualia= Formal = y holds x
Telic = z uses y to access x
Agentive = z produces x/y

Elements such as [+information], [+rational agent], [+holds] and others are sub-root semantic features.

One striking characteristic of Pustejovsky's hypothesis is the austerity of I-meaning's structural description. The I-meaning [book] offers a example of this. One could argue that such a bare description is not sufficient to capture the semantic properties of I-meanings. This is one of the main criticisms made by Fodor and Lepore (1998) against Pustejovsky. But this criticism is wrong-headed for reasons I mentioned above. In fact, the austerity or 'underspecification' of I-meanings is a necessary condition for creative language use, claims Pustejovsky. His model makes I-meanings sufficiently detailed to be useful, but also sufficiently open-ended to be useable in a wide range of situations. Specifically, I-meanings determine *at most* the necessary conditions of adequate use (Moravcsik, 1990). Taking the case of [book], its semantic 'underspecification' is what allowed it to be used appropriately in the new context of information technologies. Historically, [book] was used when talking about written work in paper format. Recently authors have started to make their work available in electronic format also. People naturally started using [book] to talk about the electronic version of written works despite the radical change in medium (e.g., paper versus byte.) [Book] allows for this new use because it provides only minimal conditions of correct use (i.e., a book is an artifact that contains information) allowing for novel applications depending on contexts (e.g., metaphors, etc.).

There are other benefits to a generative and non-atomistic account of I-meaning. Consider, for instance, the concept [persuade]. One cannot apprehend the semantic value of [persuade] without having a grasp of [agent], [patient] and [goal]. Indeed, to persuade is for an agent to act on a patient in such a way that the latter accomplishes a specific goal. These three elements are truly constitutive of the semantic value of [persuade] since we cannot entertain the concept without them.[179] When we consider other concepts, we quickly notice that similar semantic analyses are ubiquitous. If we adopt the atomist hypothesis, it is difficult to explain in a principled way why such strong constitutive relationships can be found everywhere. One can always try to sweep these facts under the carpet by distinguishing between our intuitions about the structure of I-meanings and their genuine nature (i.e., atoms) (Fodor and Lepore, 1998). I think the I-meaning model is a better alternative. In this framework, [persuade] is a I-meaning constituted by the primitive sub-root semantic features [agent], [patient] and [goal] that are organized in a specific argument structure.

Additional analysis also reveals that different I-meanings depend on the same fundamental sub-root semantic constituents. The observation that certain semantic features recur is evidence that I-meanings are built out of a finite set of primitives. Take the following nominal I-meanings: [book], [city], [parliament]. There is an abstract/concrete duality that is constitutive of the semantic value of

[179] To use more technical terminology: [persuade] is a causative involving a 'small verb' [cause] (with agent and subject arguments) and a stative [intend]. See Pietroski (2003b) for a discussion approach. (Thanks to J. McGilvray for the definition of [persuade].)

[book]. Part of the perspective provided by [book] is both ‘physical object’ and ‘information’. [City] and [parliament] exhibit the same concrete/abstract duality: [city] as ‘physical location’ and ‘administrative entity’. I could list many other examples that would show how the concrete/abstract dichotomy is built right in many I-meanings. From such observations, we can put forward the hypothesis that [+abstract] and [+concrete] are primitive sub-root constituents. Given their prevalence in verbal I-meanings, we can suppose that [agent], [patient] and [goal] are also primitive sub-root semantic features. Such hypotheses are fundamentally naturalistic and must be assessed like any other empirical hypothesis, namely on the basis of its explanatory and descriptive adequacy, its accommodation with other aspects of our theory of LO, empirical data, etc. This is not a priori conceptual analysis.

The framework developed by Pustejovsky and Moravcsik is clearly a work in progress. It still requires a lot of fine-tuning and maybe some substantial modifications. Yet, the fundamental assumption of this research program seems to be correct. I-meanings are generated from a finite set of sub-root features that are internally individuated and that are available to use because of our specific biological endowment.

Conclusion

From the standpoint of contemporary analytic philosophers of language, it is easy to understand why embracing the biological rationalist research program is a difficult step to make. It involves discarding two fundamental assumptions, empiricism and externalism, that have structured most of the work done in this field over the last century. From the biological rationalist perspective, many celebrated works in philosophy of language, which are regarded as historical turning points in our quest to understand language, lose much of their luster and importance. Furthermore, the biological rationalist approach shatters the 'philosophical exceptionalism' that many philosophers take for granted.[180] By 'philosophical exceptionalism', I mean the belief that certain problems are essentially philosophical in nature and, for this reason, can only be addressed from a philosophical perspective, which has its specific method, standards of adequacy, etc. If it were not for philosophical exceptionalism, I do not think that empiricism and externalism would have become so entrenched in philosophy of language. If we accept biological rationalism, philosophical exceptionalism goes out the

[180] Not all philosophers defend philosophical exceptionalism. Quine, for example, fights this trend by advocating the 'naturalization of philosophy'. He argues that there is continuity in terms of objects and methods between natural sciences and philosophy. Maintaining this continuity is what ensures, Quine argues, that philosophy does not become a discipline that is disconnected from reality and therefore an irrelevant enterprise. Quine's attempt to naturalize philosophy proves unsuccessful because of his commitment to empiricism and externalism. Naturalization of philosophy of language requires a turn to nativism and internalism.

window. Philosophers who study language would see themselves in the same boat as those linguists, psychologists, biologists and other scientists interested in the *naturalistic* study of cognition. Their goal is to gain a better theoretical understanding of the same object: language *qua* natural object or I-language. An explanation of this natural object will be deemed satisfactory if it exhibits descriptive and explanatory adequacy, simplicity and accommodation with other accepted scientific theories. Philosophers come to this task with their own particular intellectual and theoretical background; this is what distinguishes them from linguists, psychologists, biologists *et al*. But this unique background is put to the service of the same goal that motivates other scientists of language.

Should we regret the end of philosophical exceptionalism in philosophy of language? I do not think so. It would be a source of concern if this regime had generated substantial theoretical advances in our understanding of language. But as I have tried to demonstrate in this dissertation, the stubborn defense of empiricism and externalism by philosophers has done more harm than good. By embracing biological rationalism, philosophers of language have the chance to make a significant contribution to the developing naturalistic theory of language. I think this is an opportunity that should not be missed.

Bibliography

Ackrill, J. L. 1981. *Aristotle The Philosopher*. Clarendon Press: Oxford.

Adamson, N. 1999. *Concepts and Nativism*. Ph.D. Dissertation. Montreal: McGill University.

Allen, C. & Beloff, M. 1999. *Species of Mind*. Cambridge: Harvard University Press.

Anderson, S. R. & Lightfoot, D. 2002. *The Language Organ: Linguistics as Cognitive Physiology*. Cambridge: Cambridge University Press.

Anthony, L. M. 2001. Empty Heads. *Mind & Language* 16 (2): 193-214.

Anthony, L. M. & Hornstein, N. (eds.) 2003. *Chomsky and his Critics*. Malden: Blackwell Publishing.

Aristotle. 1984. *Complete Works* (volume 2). Barnes, J. (ed.) Princeton: Princeton University Press.

____ 1971. *Complete Works* (volume 2). Barnes, J. (ed.) Princeton: Princeton University Press.

Arrington, R. L. & Glock, H.-J. (eds.) 1996. *Wittgenstein and Quine*. Oxford: Routledge.

Aslin, R. N., Saffran, J. R. & Newport, E. L. 1998. Computation of Conditional Probability Statistics by 8-month-old infants. *Psychological Science*, 9: 321-324.

Aslin, R. N., Woodward, J. Z., LaMendola, N. P. & Bever, T. G. 1998. Models of Word Segmentation in Fluent Maternal Speech to Infants. In Morgan, J. L. & Demuth, K. (eds.) *Signal to Syntax*. Mahwah: Lawrence Erlbaum Associates.

Atran, S. 2004. *In God we Trust: The evolutionary landscape of religion*. Oxford: Oxford University Press.

____ 1998. Folk Biology and the Anthropology of Science: Cognitive universals and cultural particulars. *Behaviorial and Brain Sciences* 21: 547-609.

____ 1990. *Cognitive Foundations of Natural History: Towards an anthropology of science*. Cambridge: Cambridge University Press.

Baker, M. 2005. The Creative Aspect of Language Use and Nonbiological Nativism. Manuscript. Rutgers University.

____ 2003. *Lexical Categories: Verbs, Nouns and Adjectives*. Cambridge: Cambridge University Press.

____ 2001. *The Atoms of Language: The mind's hidden rules of grammar*. New York: Basic Books.

____ 1996. *The Polysynthesis Parameter*. Oxford: Oxford University Press.

Barber, A. (ed.) 2003. *Epistemology of Language*. Oxford: Oxford University Press.

Baron-Cohen, S. 2003. *The Essential Difference: The truth about the male and female brain*. New York: Basic Books.

____ 1997. *Mindblindness: An Essay on Autism and Theory of Mind*. Cambridge: MIT Press.

Barret, G. B. & Gibson, R. F. (eds.) 1993. *Perspectives on Quine*. Malden: Blackwell Publishing.

Batchelder, E. O. 2002. Bootstrapping the Lexicon: A computational model of infant speech segmentation. *Cognition* 83: 167-206.

Bates E. & Elman, J. 2000. The Ontogeny and Phylogeny of Language: a neural network perspective. In Parker, S. T., Langer, J. & McKinney, M. L. (eds.) *Biology, Brains and Behavior: The evolution of human development*. Santa Fe: School of American Research.

Bavin, E. L. 1995. Language Acquisition in Crosslinguistic Perspective. *Annual Review of Anthropology* 24: 193-214.

Bellugi, U., Lichtenberger, L., Jones, W., Lai, Z., & St. George, M. 2000. The Neurocognitive Profile of Williams Syndrome: A Complex Pattern of Strengths and Weaknesses. *Journal of Cognitive Neurosciences* (12) Supplement,:7-29.

Berko, J. 1958. The child's learning of English morphology. *Word* 14: 150-177.

Bickerton, D. 2001. How to Acquire Language without Positive Evidence: What acquisitionists can learn from Creoles. In Degraff, M. (ed.) *Language*

Creation and Language Change: Creolization, diachrony and development. Cambridge: MIT Press.

____ 1995. *Language and Human Behavior*. Seattle: University of Washington Press.

Bishops, M. A. & Stich, S. 1998. The Flight to Reference, or How *Not* to Make Progress in the Philosophy of Science. *Philosophy of Science* 65 (1): 33-49.

Bloom, P. 2000. *How Children Learn the Meanings of Words*. Cambridge: MIT Press.

Bloom, P. & Markson, L. 1998. Capacities Underlying Word Learning. *Trends in Cognitive Sciences* 2 (2): 67-73.

Bloomfield, L. 1987. *Leonard Bloomfield Anthology* (Abridge Edition, Edited by Hockett). Chicago: Chicago University Press.

____ 1983. *An Introduction to the Study of Language* (Edited by Kess). Amsterdam: John Benjamins Publishing Company.

____ 1966. *Language*. New York: Holt, Rinehart and Winston.

Braine, M. D. S. 1971. On two types of models of the internalization of grammars. In Slobin, D. I. (ed.) *The ontogenesis of grammar: A theoretical symposium*. New York: Academic Press.

Brandom, R. B. 1994. *Making it Explicit: Reasoning, representing and discursive commitment*. Cambridge: Harvard University Press.

____ 2000. *Articulating Reasons*. Cambridge: Harvard University Press.

Brown, R. 1958. *Words and Things*. New York: Free Press.

____ 1973. *A first language: The early stages*. Cambridge: Harvard University Press.

Brown, R. & Hanlon, C. 1970. Derivational complexity and order of acquisition in child speech. In Hayes, J. R. (ed.) *Cognition and the development of language*. New York: Wiley.

Burge, T. 1993. Individualism and Psychology. In Goldman, A. I. (ed.) *Readings in Philosophy and Cognitive Science*. Cambridge: MIT Press.

____ 1979. Individualism and the Mental. *Midwest Studies* 4.

Cain, M. J. 2002. *Fodor: Language, mind and philosophy*. Cambridge: Polity Press.

Cairns, P., Shillcock, R., Chater, N., & Levy, J. 1997. Bootstrapping Word Boundaries: a bottom-up corpus-based approach to speech segmentation. *Cognitive Psychology* 33: 111-153.

Canfield, J. V. 1996. The Passage into Language: Wittgenstein versus Quine. In Arrington, R. L. & Glock, H.-J. (eds.) *Wittgenstein and Quine*. Oxford: Routledge.

Calvin, W. H. & Bickerton, D. 2000. *Lingua ex Machina: Reconciling Darwin and Chomsky with the Humain Brain*. Cambridge: MIT Press.

Carroll, S. B. 2005. *Endless Forms Most Beautiful: The New Science of Evo Devo*. New York: W. W. Norton & Company.

Carroll, S. B., Grenier, J. K. & Weatherbee, S. D. 2004. *From DNA to Diversity: Molecular Genetics and the Evolution of Animal Design*. London: Blackwell.

Carruthers, P. 1992. *Human Knowledge and Human Nature: A new introduction to an ancient debate*. Oxford: Oxford University Press.

____ 2001. Keep Taking the Modules. *Times Literary Supplement* (October 5, 2001).

Carruthers, P. & Chamberlain, A. (eds.) 2000.   *Evolution and the Human Mind: Modularity, language and meta-cognition*. Cambridge: Cambridge University Press.

Chalmers, D. J. *The Conscious Mind: In Search of a Fundamental Theory*. Oxford: Oxford University Press.

Chomsky, N. 2005. Three Factors in Language Design. *Linguistic Inquiry* 36 (1): 1-22.

____ 2002. *On Nature and Language*. Cambridge: Cambridge University Press.

____ 2002. *Cartesian Linguistics: A chapter in the history of rationalist thought*. Christchurch: Cybereditions.

____ 2000. *New Horizons in the Study of Language and Mind*. Cambridge: Cambridge University Press.

____ 1997. *Perspectives on Power: Reflections on human nature and the social order*. Montreal: Black Rose Books.

____ 1996. *The Minimalist Program*. Cambridge: MIT Press.

____ 1991. Linguistics and Adjacent Fields: A personal view. In Kasher, A. (ed.) *The Chomskyan Turn*. Malden: Blackwell Publishing.

____ 1991. Linguistics and Cognitive Science: Problems and mysteries. In Kasher, A. (ed.) *The Chomskyan Turn*. Malden: Blackwell Publishing.

____ 1988. *Language and Politics*. Montreal: Black Rose Books.

____ 1987. *Language and Problems of Knowledge: The Managua lectures*. Cambridge: MIT Press.

____ 1986. *Knowledge of Language: Its nature, origin and use*. Westport: Praeger.

____ 1986. *Barriers*. Cambridge: MIT Press.

____ 1981. *Some Concepts and Consequences of the Theory of Government and Binding*. Cambridge: MIT Press.

____ 1981. Principles and Parameters in Syntactic Theory. In Horstein, N. & Lightfoot, D. (eds.) *Explanation in linguistics: the logical problem of language acquisition*. London: Longmans.

____ 1980. *Rules and Representations*. New York: Columbia University Press.

____ 1980. Initial States and Steady States. In Piattelli-Palmarini, M. (ed.) *Language and Learning: The debate between Jean Piaget and Noam Chomsky*. Cambridge: Harvard University Press.

____ 1975. *Reflections on Language*. New York: Pantheon.

____ 1975. Recent Contributions to the Theory of Innate Ideas. In Stich, S. (ed.) *Innate Ideas*. Berkeley: University of California Press.

____ 1975. Linguistics and Philosophy. In Stich, S. (ed.) *Innate Ideas*. Berkeley: University of California Press.

____ 1972. *Studies on Semantics in Generative Grammar*. The Hague: Mouton.

____ 1971. *Problems of Knowledge and Freedom*. New York: Pantheon.

____ 1969. *Current Issues in Linguistic Theory*. The Hague: Mouton.

____ 1965. *Aspects of the Theory of Syntax*. Cambridge: MIT Press.

____ 1967. A Review of B. F. Skinner's *Verbal Behavior*. In Jakobovits. L. A. & Miron, M. S. (eds.) *Readings in the Psychology of Language*. Prentice-Hall.

Chomsky, N. & Fodor, J. 1980. The Inductivist Fallacy. In Piattelli-Palmarini, M. (ed.) *Language and Learning: The debate between Jean Piaget and Noam Chomsky*. Cambridge: Harvard University Press.

Chomsky, N. & Halle, M. 1968. *The Sound Pattern of English*. New York: Harper Row.

Chouinard, M. M. & Clark, E. V. 2003. Adult Reformulations of Child Errors as Negative Evidence. *Journal of Child Language* 30: 637-669.

Christiansen, M. H., Allen, J. & Seidenberg, M. S. 1998. Learning to Segment Speech Using Multiple Cues: A connectionist model. *Language and Cognitive Processes* 13 (2/3): 221-268.

Churchland, P. 1995. *The Engine of Reason, the Seat of the Soul*: *A philosophical journey into the brain*. Cambridge: MIT Press.

Clahsen, H. & Almazan, M. 1998. Syntax and Morphology in Williams Syndrome. *Cognition* 68: 167-198.

Collins, G. M. 1977. Visual co-orientation and maternal speech. In Schaffer, H. R. (ed.) *Studies in mother-infant interaction*. London: Academic Press.

Collins, J. 2004. Faculty Disputes. *Mind and Language* 19 (5): 503-533.

Cook, V. J. & Newson, M. 1996. *Chomsky's Universal Grammar* (second edition). Cambridge: Harvard University Press.

Cowie, F. 2001. On Cussing in Church: In defense of *What's Within*. *Mind and Language* 16 (2): 231-245.

____ 1999. *What's Within: Nativism reconsidered*. Oxford: Clarendon Press.

____ 1997. The Logical Problem of Language Acquistion. *Synthese* 111: 17-51.

Crago, M. B., Allen, S. E. M. & Hough-Eyamie, W. P. 1997. Exploring Innateness through Cultural and Linguistic Variation. In Gopnik, M. (ed.) *The Inheritance and Innateness of Grammars*. Oxford: Oxford University Press.

Crain, S. 1991. Language Acquisition in the Absence of Experience. *Behavioral and Brain Sciences* 14: 597-650.

Crain, S. & Lillo-Martin, D. 1999. *An introduction to Linguistic Theory and Language Acquisition*. Oxford: Oxford University Press.

Crain, S. & Nakayama, M. 1987. Structure dependence in grammar formation. *Language* 63: 522-543.

Crain, S. & Pietroski, P. 2002. Why Language Acquisition is a Snap. *The Linguistic Review* 19: 163-183.

____ 2001. Nature, Nurture and Universal Grammar. *Linguistics and Philosophy* 24, 139-186.

Crain, S., Gualmini, A. & Pietroski, P. Forthcoming. Brass Tacks in Linguistic Theory: Innate Grammatical Principles. Sheffield Innateness Project.

Crain, S. & Thornton, R. 1998. *Investigations in Universal Grammar: A Guide to Experiments on the Acquisition of Syntax and Semantics*. Cambridge: MIT Press.

Crommer, R. 1994. A Case Study of Dissociations Between Language and Cognition. In Tages-Flusberg, H. (ed.) *Constraints on Language Acquisition: Studies of atypical children*. Hillsdale: Lawrence Erlbaum Associates.

Cummins, D. & Allen, C. 1998. *The Evolution of Mind*. Oxford: Oxford University Press.

Cummins, R. 1997. The Lot of the Causal Theory of Mental Content. *The Journal of Philosophy* 94 (10): 535-542.

Curtiss, S. 1977. *Genie: A psycholinguistic study of a modern-day "wild child"*. London: Academic Press.

D'agostino, F. 2001. Double Review: *Chomsky: Ideas and Ideals* and *Chomsky: Language, mind and politics*. *Mind and Language* 16 (3): 335-344.

____ 1986. *Chomsky's System of Ideas*. Oxford: Clarendon Press.

Dancy, J. & Sosa, E. 1991. *A Companion to Epistemology*. Malden: Blackwell Publishing.

Davidson, D. 1997. Seeing through Language. In Preston, J. (ed.) *Thought and Language* (Royal Institute of Philosophy Supplement: 42). Cambridge: Cambridge University Press.

____ 1994. The Social Aspect of Language. In McGuinness, B. (ed.) *The Philosophy of Michael Dummett*. Dordrecht: Kluwer.

____ 1986. A Nice Derangement of Epitaphs. In Grandy, R. & Warner, R. (eds.) *Philosophical Grounds of Rationality*. Oxford: Clarendon Press.

____ 1984. *Inquiries in Truth and Interpretation*. Oxford: Clarendon Press.

Davidson, D. & Harman, G. (eds.) 1973. *Semantics of Natural Language*. New York: Springer.

Dawkins, R. 1982. *The Extended Phenotype*. Oxford: Oxford University Press.

Degraff, M. (ed.) 2001. *Language Creation and Language Change: Creolization, diachrony and development*. Cambridge: MIT Press.

____ 2001(a) Creolization, Language Change, and Language Acquisition: A prolegomenon. In Degraff, M. (ed.) *Language Creation and Language Change: Creolization, diachrony and development*. Cambridge: MIT Press.

Dennett, D. 1995. *Darwin's Dangerous Idea: Evolution and the meaning of life*. New York: W.H. Freeman and Company.

Depew, D. J. & Weber, B. 1996. *Darwinism Evolving*. Cambridge: Polity Press.

Deprez, V. & Pierce, A. 1993. Negation and Functional Projections in Early Child Grammar. *Linguistic Inquiry* 24: 25-68.

Descartes, R. 1953. *Oeuvres Complètes*. Paris: Gallimard

Devitt, M. & Sterelny, K. 1999. *Language and Reality: An introduction to philosophy of language*. Cambridge: MIT Press.

Donnellan, K. 1994. Reference and Definite Description. In Harnish, R. M. (ed.) *Basic Topics in the Philosophy of Language*. Englewood Cliffs: Prentice Hall.

Dretske, F. 1981. *Knowledge and the Flow of Information*. Cambridge: MIT Press.

Dummett, M. 1996 (a). *Origins of Analytic Philosophy*. Cambridge: Harvard University Press.

____ 1996 (b). *The Seas of Language*. Oxford: Oxford University Press.

____ 1986. 'A Nice Derangement of Epitaths': Some Comments on Davidson and Hacking. In Lepore, E. (ed.) *Truth and Interpretation: Perspectives on the philosophy of Donald Davidson*. Oxford: Basil Blackwell.

____ 1981. *The Interpretation of Frege's Philosophy*. London: Duckworth.

____ 1981. *Frege: Philosophy of language* (second edition). London: Duckworth.

____ 1978. *Truth and Other Enigmas*. Cambridge: Harvard University Press.

Egan, F. 2003. Naturalistic Inquiry: Where does mental representation fit in? In Anthony, L. M. & Hornstein, N. (eds.) *Chomsky and his Critics*. Malden: Blackwell Publishing.

____ 1999. In Defense of Narrow Mindedness. *Mind and Language* 14 (2): 177-194.

Elman, J. L. 1991. Distributed representations, simple recurrent networks, and grammatical structures. *Machine Learning* 7: 195-224.

Elman, J. L. *et al.* 1996. *Rethinking Innateness: A connectionist perspective on development*. Cambridge: MIT Press.

Eubank, L. & Gregg, K. R. 2002. News Flash—Hume is still Dead. *Studies in Second Language Acquisition* 24: 237-247.

Evine, S. 1991. *Donald Davidson*. Stanford: Stanford University Press.

Fauconnier, G. 2001. Conceptual Blending and Analogy. In Genter, D., Holyoak, K. J. & Kokinov, B. N. (eds.) *The Analogical Mind: Perspectives from cognitive science*. Cambridge: MIT Press.

Fauconnier, G. & Turner, M. 2002. *The Way We Think: Conceptual Blending and the Mind's Hidden Complexities*. New York: Basic Books.

Finney, M. A. 2004. Substratal Influence on the Morphosyntactic Properties of Krio. *Linguistic Discovery* 2 (2): 58-83.

Fisher, C. 2002. The Role of Abstract Syntactic Knowledge in Language Acquisition: a reply to Tomasello (2000). *Cognition* 82: 259-278.

Fisher, S. E. & Marcus, G. F. 2006. The eloquent ape: genes, brain and the evolution of language. *Nature Review Genetics.*

Fitzgerald, M. 2004. *Autism and Creativity: Is there a link between autism in men and exceptional ability*. Hove: Brunner-Routledge.

Fodor, J. A. 2004. Water's Water Everywhere. *London Review of Books* 26 (20).

_____ 2001. Doing Without What's Within: Fiona Cowie's critique of nativism. *Mind* 110: 99-118.

____ 2000. *The Mind Doesn't Work that Way: The scope and limits of computational psychology*. Cambridge: MIT Press.

____ 1998. *Concepts: Where cognitive science went wrong*. Oxford: Oxford University Press.

____ 1995. *The Elm and the Expert*. Cambridge: MIT Press.

____ 1983. *Representations: Philosophical essays on the foundations of cognitive science*. Cambridge: MIT Press.

____ 1983. *The Modularity of Mind: An essay on faculty psychology*. Cambridge: MIT Press.

____ 1975. *The Language of Thought*. Cambridge: Harvard University Press.

Fodor, J. A. & Lepore, E. 1998. The Emptiness of the Lexicon: Critical reflections on J. Pustejovsky's *The Generative Lexicon*. Linguistic Inquiry 29 (2): 269-288.

____ 1992. *Holism: A Shopper's Guide*. Malden: Blackwell Publishing.

Fodor, J. A. & Pylyshyn, Z. 1988. Connectionism and Cognitive Architecture: A critical analysis. *Cognition 28*: 3-71.

Fodor, J. A., Garrett, M. F., Walker, E. C. T. & Parkes, C. H. 1980. Against Definitions. *Cognition* 8: 262-270.

Fodor, J. D. 1998. Unambiguous Triggers. *Linguistic Inquiry* 29 (1): 1-36.

Fodor, J. D. & Crowther, C. 2002. Understanding Stimulus Poverty Arguments. *The Linguistic Review* 19: 105-145.

Fodor, J. D. & Crain, S. 1987. Simplicity and Generality of Rules in Language Acquisition. In MacWhinney, B. (ed.) *Mechanisms of Language Acquisition*. Hillsdale: Lawrence Erlbaum Associates

Follesdal, D. 1995. In What Sense is Language Public. In Leonardi, P. & Santambrogio, M. (eds.) *On Quine: New essays*. Cambridge: Cambridge University Press.

Fowler, A. E., Gelman, R. & Gleitman, L. R. 1995. The Course of Language Learning in Children with Down Syndrome. In Tages-Flusberg, H. (ed.) *Constraints on Language Acquisition: Studies of atypical children*. Hillsdale: Lawrence Erlbaum Associates.

Frawley, W. J. (ed.) 2003. *International Encyclopedia of Linguistics*. Oxford: Oxford University Press.

Frege, G. 1994. On Sense and Reference. In Harnish, R. M. (ed.) *Basic Topics in the Philosophy of Language*. Englewood Cliffs: Prentice Hall.

Freidin, R. 1991. Linguistic Theory and Language Acquisition: A note on structure dependence. *Behavioral and Brain Sciences*. 14 (2): 618-619.

Fromkin, V. (ed.) 2000. *Linguistics: An introduction of linguistic theory*. Malden: Blackwell Publishing.

Grant, J., Valian, V. & Karmiloff-Smith, A. 2002. A study of relative clauses in Williams syndrome. *Journal of Child Language* 29: 403-416.

Genter, D., Holyoak, K. J. & Kokinov, B. N. (eds.) 2001. *The Analogical Mind: Perspectives from cognitive science*. Cambridge: MIT Press.

Gleitman, L. R. 1990. Structural Sources of Verb Learning. *Language Acquisition* 1: 1-63.

Gleitman, L. R. & Liberman, M. (eds.) 1995. *An Invitation to Cognitive Science: Language (volume 1)*, Cambridge: MIT Press.

Gleitman, L. R. & Newport, E. L. 1995. The Invention of Language by Children: Environmental and Biological Influences on the Acquisition of Language. In Gleitman, L. R. & Liberman, M. (eds.) *An Invitation to Cognitive Science: Language (volume 1)*, Cambridge: MIT Press.

Gleitman, L. R., Newport, E. L. & Gleitman, H. 1984. The Current Status of the Motherese Hypothesis. *Journal of Child Language* 11: 43-79.

Glock, H.-J. 2003. *Quine and Davidson on Language, Thought and Reality*. Cambridge: Cambridge University Press.

____ 1996. On Safari with Wittgenstein, Quine and Davidson. In Arrington, R. L. & Glock, H.-J. (eds.)*Wittgenstein and Quine*. Oxford: Routledge.

Goldin, S. 2003. *The Resilience of Language: What gesture creation in deaf children can tell us about how all children learn language*. New York: Psychology Press.

Goldin-Meadow, S. & Mylander, C. 1998. Spontaneous Sign Systems Created by Deaf Children in Two Cultures. *Nature* 391 (15): 279-281

Goldman, A. I. (ed.) 1993. *Readings in Philosophy and Cognitive Science*. Cambridge: MIT Press.

Goldstone, R. L. & Medin, D. L. 1994. Time Course of Comparison. *Journal of Experimental Psychology* 20: 1, 29-50.

Gopnik, M. (ed.) 1997. *The Inheritance and Innateness of Grammars*. Oxford: Oxford University Press.

Gopnik, M. & Crago, M. B. 1991. Familial Aggregation of a Developmental Language Disorder. *Cognition* 39: 1-50.

Gopnik, M., Dalalakis, J., Fukuda, S. E. & Fukuda, S. 1997. The Biological Basis of Language: Familial Language Impairment. In Gopnik, M. (ed.) *The Inheritance and Innateness of Grammars*. Oxford: Oxford University Press.

Gordon, P. 1986. Level-ordering in lexical development. *Cognition* 21, 73-93.

Goswami, U. 2001. Analogical Reasoning in Children. In Genter, D., Holyoak, K. J. & Kokinov, B. N. (eds.) *The Analogical Mind: Perspectives from cognitive science*. Cambridge: MIT Press.

Gould, S. J. & Lewontin, R. C. 1979. The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Program. *Proceedings of the Royal Society of London.* Series B, 205 (1161): 581-598.

Grandy, R. & Warner, R. (eds.) 1986. *Philosophical Grounds of Rationality*. Oxford: Clarendon Press.

Grant, J., Valian, V. & Karmiloff-Smith, A. 2002. A Study of Relative Clauses in Williams Syndrome. *Journal of Child Language* 29: 403-416

Green, K. 2001. *Dummett: Philosophy of language*. Cambridge: Polity Press.

Grice, H. P. 1994. *Meaning*. In Harnish, R. M. (ed.) *Basic Topics in the Philosophy of Language*. Englewood Cliffs: Prentice Hall.

Griffiths, P. 2002. What is Innateness? *The Monist* 85 (1): 70-85.

Guasti, M. T. 2002. *Language Acquisition: a linguistic perspective*. Cambridge: MIT Press.

Gunson, D. 1998. *Micheal Dummett and the Theory of Meaning*. Brookfield: Ashgate.

Hacking, I. 1990. Natural Kinds. In Barret, G. B. & Gibson, R. F. (eds.) 1993. *Perspectives on Quine*. Malden: Blackwell Publishing.

____ 1986. The Parody of Conversation. In Lepore, E. (ed.) *Truth and Interpretation: Perspectives on the philosophy of Donald Davidson*. Oxford: Basil Blackwell.

Hadley, R. F. & Hayward, M. B. 1997. Strong Semantic Systematicy from Hebbian Connectionist Learning. *Minds and Machine* 7: 1-37.

Haggan, M. 2002. Self-reports and Self-delusion Regarding the Use of Motherse: Implications from Kuwaiti adults. *Language Sciences* 24: 17-28

Hale, M. & Reiss, C. 2003. The Subset Principle in Phonology: Why the *tabula* can't be *rasa*. *Journal of Linguistics* 39: 219-244.

Hall, D. G. 1994. Semantic Constraints on Word Learning: Proper Names and Adjectives. *Child Development* 85 (5): 1299-1317.

Harman, G. (ed.) 1982. *On Noam Chomsky: Critical Essays*. Garden City: Anchor.

Harnish, R. M. (ed.) 1994. *Basic Topics in the Philosophy of Language*. Englewood Cliffs: Prentice Hall.

Harris, M., Jones, D. & Grant, J. 1983. The nonverbal content of mothers' speech to infants. *First Language* 4: 21-31.

Hauser, M. D. 1996. *The Evolution of Communication*. Cambridge: MIT Press.

Hauser, M. D., Chomsky, N. & Fitch, W. T. 2002. The Faculty of Language: What is it, Who has it, and How did it evolve? *Science* 298: 1569-1579.

Heath, S. B. 1983. *Ways with words: Language, life and work in communities and classrooms*. New York: Cambridge University Press.

Hinzen, W. 2002. Meaning By Necessity: Some reflections on grammar design. Manuscript.

Hinzen, W. & Rott, H. (eds.) 2002. *Belief and Meaning: Essays at the Interface*, Hansel-Hohenhausen.

Hirsk-Pasek, K., Treiman, R. & Schneiderman, M. 1984. Brown & Halon Revisited: Mother's Sensitivity to Ungrammatical Forms. *Journal of Child Language* 11 (1) 81-88.

Holyoak, K. J. & Hummel, J. E. 2001. Toward an Understanding of Analogy within a Biological Symbol System. In Genter, D., Holyoak, K. J. & Kokinov, B. N. (eds.)*The Analogical Mind: Perspectives from cognitive science*. Cambridge: MIT Press.

Hookway, C. 1988. *Quine: Language, experience and reality*. Stanford: Stanford University Press.

Hornstein, H. 2005. Empiricism and Rationalism as Research Programs. In McGilvray, J. (ed.) *The Cambridge Companion to Chomsky*. Cambridge: Cambridge University Press.

____ 1995. *Logical Form: From GB to minimalism*. Malden: Blackwell Publishing.

____ 1991. Grammar, Meaning and Indeterminacy. In Kasher, A., ed., *The Chomskyan Turn*. Malden: Blackwell Publishing.

Hornstein, N. & Lightfoot, D. (eds.) 1981. *Explanation in linguistics: the logical problem of language acquisition*. London: Longmans.

Howlin, P., Davies, M. & Udwin, O. 1998. Cognitive Functioning in Adults with Williams Syndrome. *Journal of Child Psychology* 29 (2): 183-189.

Hughes. C. 2004. *Kripke: Names, Necessity and Identity* Oxford: Oxford University Press.

Hume, D. 1981. *An Enquiry Concerning Human Understanding*. Indianapolis: Hackett Publishing.

____ 1978. *A Treatise of Human Nature*. Oxford: Oxford University Press.

Jacob, F. 1982. *The Possible and the Actual*. Seattle: University of Washington Press.

Jackendoff, R. 2002. *Foundations of Language*. Oxford: Oxford University Press.

____ 1999. Possible Stages in the Evolution of the Language Capacity. *Trends in Cognitive Sciences* 3 (7): 272-279.

____ 1994. *Patterns in the Mind: Language and human nature*. New York: Basic Books.

Jenkins, L. 2000. *Biolinguistics: Exploring the biology of language*. Cambridge: Cambridge University Press.

Jerne, N. K. 1985. The Generative Grammar of the Immune System. *Science* 229 (4718): 1057-1059.

Jolley, N. 1999. *Locke: His philosophical thought*. Oxford: Oxford University Press.

Johnson, S. C. & Carey, S. 1998. Knowledge Enrichment and Conceptual Change in Folkbiology: Evidence from Williams Syndrome. *Cognitive Psychology* 37: 156-200.

Kaplan, D. 1975. How To Russell a Frege-Church. *Journal of Philosophy* 72: 716-729.

Karmiloff-Smith, A., Grant, J., Berthoud, I. Davies, M., Howlin, P. & Udwin, O. 1997. Language and Williams syndrome: how intact is intact? *Child Development* 68: 246-262.

Kasher, A. (ed) 1991. *The Chomskyan Turn*. Malden: Blackwell Publishing.

____ 1991. Pragmatics in Chomsky's Research Program. In Kasher, A. (ed.) *The Chomskyan Turn*. Malden: Blackwell Publishing.

Kegl, J., Senghas, A. & Coppola, M. 2001. Creation through Contact: Sign language emergence ands sign language change in Nicaragua. In Degraff, M. (ed.) *Language Creation and Language Change: Creolization, diachrony and development*. Cambridge: MIT Press.

Kegl, J. & Lopez, A. 1990. The Deaf Community in Nicaragua and their Sign Language(s). Manuscript, Rutgers University.

Kegl, J. & Iwata, G. A. 1989. Language de Signos Nicaraguense: A pidgin sheds light on the “creole”. *Proceedings of the Fourth Annual Meeting of the Pacific Linguistics Conference*. Eugene: University of Oregon.

Keil, F. C. 1989. *Concepts, Kinds and Cognitive Development*. Cambridge: MIT Press.

Kenstowicz, M. 1994. *Phonology in Generative Grammar*. Malden: Blackwell Publishing.

Kein, M. T. & Costello, F. 2001. Setting Limits on Analogy. In Genter, D., Holyoak, K. J. & Kokinov, B. N. (eds.) 2001. *The Analogical Mind: Perspectives from cognitive science*. Cambridge: MIT Press.

Khalidi, M. 2002. Nature and Nurture in Cognition. *British Journal for the Philosophy of Science* 53: 251-272.

Kim, J. 1996. *Philosophy of Mind*. Boulder: Westview Press.

Kirkham, N. Z., Slemmer, J. A. & Johnson, S. P. 2002. Visual Statistical Learning in Infancy: Evidence for domain general learning mechanism. *Cognition* 83: B35-B42.

Knobe, J. 2003. Intentional Action in Folk Psychology: An Experimental Investigation. *Philosophical Psychology,* 16: 309-324

Kripke, S. 1982. *Wittgenstein on Rules and Private Language: An elementary exposition*. Cambridge: Harvard University Press.

____ 1980. *Naming and Necessity*. Cambridge: Harvard University Press.

Landau, B., & Gleitman, L. R. 1985. *Language and experience: Evidence from the blind child.* Cambridge: Harvard University Press.

Lasnik, H. 2005. Grammar, levels and biology. In McGilvray, J. (ed.) *The Cambridge Companion to Chomsky*. Cambridge: Cambridge University Press.

Lasnik, H. & Uriagereka, J. 2002. On the Poverty of the Challenge. *The Linguistic Review* 19: 147-150.

Laurence, S. & Margolis, E. 2002. Radical Concept Nativism. *Cognition* 86: 25-55.

____ 2001. The Poverty of Stimulus Argument. *British Journal for the Philosophy of Science* 52: 217-276.

Legate, J. A. & Yang, C. D. 2002. Empirical Re-assessment of Stimulus Poverty Arguments. *The Linguistic Review* 19: 151-162.

Leonardi, P. & Santambrogio, M. (eds.) 1995. *On Quine: New essays*. Cambridge: Cambridge University Press.

Lepore, E. (ed.) 1986. *Truth and Interpretation: Perspectives on the philosophy of Donald Davidson*. Oxford: Basil Blackwell.

Lidz, J., Gleitman, H. & Gleitman, L. 2003. Understanding How Input Matters: Verb learning and the footprint of universal grammar. *Cognition* 87: 151-178.

Lightfoot, D. 2005. Plato's Problem, UG, and the Language Organ. In McGilvray, J. (ed.) *The Cambridge Companion to Chomsky*. Cambridge: Cambridge University Press.

____ (ed.) 2002. *Syntactic Effects of Morphological Change*. Oxford: Oxford University Press.

____ 1999. *The Development of Language: Acquisition, change, evolution*. Malden: Blackwell Publishing.

____ 1991. *How to Set Parameters*. Cambridge: MIT Press.

____ 1989. The Child's Trigger Experience: Degree-0 learnability. *Behavioral and Brain Sciences* 12: 321-375.

____ 1982. *The Language Lottery: Toward a Biology of Grammars*. Cambridge: MIT Press.

Lipton, P. 2004. *Inference to the Best Explanation*. London: Routledge.

Locke, J. 1975. *An Essay Concerning Human Understanding*. Oxford: Oxford University Press.

Lycan, W. G. 2000. *Philosophy of Language: A contemporary introduction*. London: Routledge.

Lyons, W. 2001. *Matters of the Mind*. London: Routledge.

Macherie, E., Mallon, R., Nichols, S. & Stich, S. 2004. Semanticvs, Cross-Cultural Style. *Cognition* 92: B1-B12.

MacLaurin, J. 2002. The Resurrection of Innateness. *The Monist* 85 (1): 70-86

MacWhinney, B. (ed.) 1987. *Mechanisms of Language Acquisition*. Hillsdale: Lawrence Erlbaum Associates.

Marcus, G. 2006. Cognitive Architecture and Descent with Modification. *Cognition* 101: 443-465.

____ 2003. *The Algebraic Mind: Integrating connectionism and cognitive science*. Cambridge: MIT Press.

____ 1999. Connectionism with or without Rules? Response to J. L. McClelland and D. C. Plaut. *Trends in Cognitive Sciences* 3 (5): 168-170.

____ 1998. Rethinking Eliminative Connectionism. *Cognitive Psychology* 37: 243-282.

____ 1993. Negative Evidence in Language Acquisition. *Cognition* 46: 53-85.

Marr, D. 1982. *Vision: A computational investigation into the human representation and processing of visual information*. New York: Henry Holt & Company.

Mattews, R. J. 2001. Cowie's Anti-Nativism. *Mind and Language* 16 (2): 215-230.

____ 1991. Psychological Reality of Grammars. In Kasher, A. (ed.) *The Chomskyan Turn*. Malden: Blackwell Publishing.

McGilvray, J. 2005 (a). Meaning and creativity. In McGilvray, J. (ed.) *The Cambridge Companion to Chomsky*. Cambridge: Cambridge University Press.

____ (ed.) 2005 (b). *The Cambridge Companion to Chomsky*. Cambridge: Cambridge University Press.

____ 2003. Commonsense Concepts: A Cartesian proposal. *Croatian Journal of Philosophy* 3 (9).

____ 2002. MOP: The science of concepts. In Hinzen, W. & Rott, H., eds., *Belief and Meaning: Essays at the Interface*, Hansel-Hohenhausen.

____ 1999. *Chomsky: Language, mind and politics*. Cambridge: Polity Press.

____ 1998. Meanings are Syntactically Individuated and Found in the Head. *Mind and Language* 13 (2), 225-280.

McKay. S. 2005. La Nouvelle Vague de l'Empirisme Conceptuel. In Lapointe, S. & Lepage, F. (eds.) *Actes du Colloque de la SOPHA - Montréal 2003*. *Publications Electroniques de Philosophia Scientiae* Volume 2.

McNeill, D. 1966. Developmental psycholinguistics. In Smith, F. & Miller, G., eds., *The genesis of language*. Cambridge: MIT Press.

Medin, D. & Ortony, A. 1989. Psychological Essentialism. In *Similarity and Analogical Reasoning*. Vosniadou, S. & Ortony, A. (eds.) New York: Cambridge University Press.

Millikan, R. 2004. *Varieties of Meaning: The 2002 Jean Nicod Lectures.* Cambridge: MIT Press.

Mohanan, K. P. 1992. Describing the Phonology of Non-Native Varieties of Language. National University of Singapore ms.

Mondée, J. 2000. Observation Sentences and Joint Attention. *Synthese* 124: 221-238.

Moravscik, J. 2002. Chomsky's New Horizons. *Mind and Language* 17 (3): 303-311.

____ 1998. *Meaning, Creativity, and the Partial Inscrutability of the Human Mind*. Stanford: CSLI.

____ 1992. *Thought and Language*. London: Routledge.

Morgan, G., Smith, N., Tsimpli, I. & Woll, B. 2002. Language against the Odds: The learning of British Sign Language by a polyglot *savant*. *Journal of Linguistics* 38: 1-41.

Morgan, J. L. 1989. *From Simple Input to Complex Grammar*. Cambridge: MIT Press.

Morgan, J. L. & Demuth, K. (eds.) 1998. *Signal to Syntax*. Mahwah: Lawrence Erlbaum Associates.

Nagel, T. 1974. What Is It Like to Be a Bat. *The Philosophical Review* 83: 435-450.

Newport, E. 1999. Reduced input in the acquisition of signed languages: Contributions to the study of creolization. In DeGraff, M. (ed.) *Language*

Creation and Language Change: Creolization, Diachrony, and Development. Cambridge: MIT Press.

Newport, E., Gleitman, H. & Gleitman, E. 1977. Mother I'd rather do it myself: Some effects and non-effects of maternal speech style. In Snow, C. E. & Ferguson, C. A. (eds.) *Talking to children: Language input and acquisition*. Cambridge: Cambridge University Press.

Noonan, H. W. 2001. *Frege: A critical introduction*. Cambridge: Polity Press.

Nuccetelli, S. 2003. *New Essays on Semantics Externalism and Self-Knowledge*. Cambridge: MIT Press.

Obler, L. K., & Gjerlow, K. 1999. *Language and the brain*. Cambridge: Cambridge University Press.

O'Connor, N. & Hermelin, B. 1991. A Specific Linguistic Ability. *American Journal on Mental Retardation* 95 (6): 673-680.

Orenstein, A. 2002. *W.V. Quine*. Princeton: Princeton University Press.

Origgi, G. & Sperber, D. 2000. Evolution, Communication and the Proper Function of Language. In Carruthers, P. & Chamberlain, A. (eds.) *Evolution and the Human Mind: Modularity, language and meta-cognition*. Cambridge: Cambridge University Press.

Oshima-Takane, Y. 1988. Children learn from speech not addressed to them: The case of personal pronouns. *Journal of Child Language* 15: 94-108.

_____ 1998. The learning of first and second person pronouns in English. In Jackendoff, R., Bloom, P. & Wynn, K. (eds.) *Language, Logic and Concept: Essays in Memory of John Macnamara*. Cambridge: MIT Press.

Ouhalla, J. 1999. *Introducing Transformational Grammar: From Principles and Parameters to Minimalism* (second edition). London: Arnold.

Pettito, L. A. 1997. In the Beginning: On the genetic and environmental factors that make early language acquisition possible. In Gopnik, M. (ed.) *The Inheritance and Innateness of Grammars*. Oxford: Oxford University Press.

Piattelli-Palmarini, M. (ed.) 1980. *Language and Learning: The debate between Jean Piaget and Noam Chomsky*. Cambridge: Harvard University Press.

Pietroski, P. M. 2005. Meaning Before Truth. In Preyer, G. & Peters, G. (eds.) *Contextualism in Philosophy*. Oxford: Oxford University Press.

____ 2003 (a). The Character of Natural Language Semantics. In Barber, A. (ed.) *Epistemology of Language*. Oxford: Oxford University Press.

____ 2003 (b). Small Verbs, Complex Events: Analyticity without Synonymy. In Anthony, L. M. & Hornstein, N. (eds.) *Chomsky and his Critics*. Malden: Blackwell Publishing.

____ 2000. Euthyphro and the Semantic: review of Jerry Fodor's *Concepts*. *Mind and Language* 15: 341-49

Pietroski, P. & Crain, S. 2005. Innate Ideas. In McGilvray, J. (ed.) *The Cambridge Companion to Chomsky*. Cambridge: Cambridge University Press.

Pinker, S. 2002. *The Blank Slate*. New York: Viking

____ 2000. *Words and Rules: The ingredients of language*. New York: Perennial.

____ 1997. Evolutionary Biology and the Evolution of Langauge. In Gopnik, M. (ed.) *The Inheritance and Innateness of Grammars*. Oxford: Oxford University Press.

____ 1995 (a). Language Acquisition. In Gleitman, L. R. & Liberman, M. (eds.) *An Invitation to Cognitive Science: Language (volume 1)*, Cambridge: MIT Press.

____ 1995 (a). Why the Child Holded the Baby Rabbits: A case study in language acquisition. In Gleitman, L. R. & Liberman, M. (eds.) *An Invitation to Cognitive Science: Language (volume 1)*, Cambridge: MIT Press.

____ 1994. *The Language Instinct*. New York: Basic Books.

____ 1991. *Learnability and Cognition: The acquisition of argument structure*. Cambridge: MIT Press.

____ 1984. *Language Learnability and Language Development*. Cambridge: Harvard University Press.

____ 1980. What is Innate and Why: Comments on the Debate. In Piattelli-Palmarini, M., ed., *Language and Learning: The debate between Jean Piaget and Noam Chomsky*. Cambridge: Harvard University Press.

Pinker, S. & Bloom, P. 1990. Natural language and natural selection. *Behavioral and Brain Sciences* 13 (4): 707-784.

Pinker, S. & Prince, A. 1988. On Language and Connectionism: Analysis of a parallel distributed processing model of language acquisition. *Cognition* 28, 73-193.

Pinker, S. & Searle, J. 2002. 'Words and Rules': an exchange. *The New York Review of Books* (June 27).

Plotkin, H. 1998. *Evolution in Mind: An introduction to evolutionary psychology*. Cambridge: Harvard University Press.

Plunkett, K. 1998. Language Acquisition and Connectionism. *Language and Cognitive Processes* 13 (2/3): 97-104.

Prince, A. & Smolensky, P. 2003. Optimality Theory in phonology. In *International Encyclopedia of Linguistics* (ed.) William John Frawley. Oxford: Oxford University Press.

Prinz, J. 2002. *Furnishing the Mind: Concepts and their perceptual basis*. Cambridge: MIT Press.

Pullum, G. K. 1996. Learnability, hyperlearning, and the poverty of the stimulus. In Johnson, J., Juge, M. L. & Moxley, J. L. (eds.) *Proceedings of the 22nd Annual Meeting: General Session and Parasession on the Role of Learnability in Grammatical Theory*. Berkeley: Berkeley Linguistics Society.

Pullum, G. K. & Scholz, B. C. 2002. Empirical assessment of stimulus poverty arguments. *The Linguistic Review* 19 (1-2): 9-50.

Putnam, H. 1994. The Meaning of "Meaning". In Harnish, R. M., ed., *Basic Topics in the Philosophy of Language*. Englewood Cliffs: Prentice Hall.

____ 1992. *Representation and Reality*. Cambridge: MIT Press.

____ 1979 (a) *Mind, Language and Reality*. Cambridge: Cambridge University Press.

____ 1979 (b) The ‘Innateness Hypothesis’ and Explanatory Models in Linguistics. In Putnam, H., *Mind, Language and Reality*. Cambridge: Cambridge University Press.

Pustejovsky, J. 1998. Generativity and Explanation in Semantics: A reply to Fodor and Lepore. *Linguistic Inquiry* 29 (2): 289-311.

____ 1995. *The Generative Lexicon*. Cambridge: MIT Press.

Pylyshin, Z. 1991. Rules and Representations: Chomsky and representational realism. In Kasher, A., ed., *The Chomskyan Turn*. Malden: Blackwell Publishing.

Quine, W. V. O. 1998. *From Stimulus to Science*. Cambridge: Harvard University Press.

____ 1990. *Pursuit of Truth*. Cambridge: Harvard University Press.

____ 1973. Methodological Reflections on Current Linguistic Theory. In Davidson, D. & Harman, G. (eds.) *Semantics of Natural Language*. New York: Springer.

____ 1970. Philosophical Progress in Language Theory. *Metaphilosophy* 1: 2-19.

____ 1969. *Ontological Relativity and Other Essays*. New York: Columbia University Press.

____ 1961. *From a Logical Point of View*. Cambridge: Harvard University Press.

____ 1960. *Word and Object*. Cambridge: MIT Press.

Recanati, F. 1993. *Direct Reference*. Oxford: Blackwell.

Reimer, M. 2001. The Problem of Empty Names. *Australasian Journal of Philosophy* 79: 491-506.

Rey, G. 2003 (a). Chomsky, Intentionality, and a CRTT. In Anthony, L. M. & Hornstein, N. (eds.) *Chomsky and his Critics*. Malden: Blackwell Publishing.

____ 2003 (b). Representational Content and a Chomskyan Linguistics. In Barber, A. (ed.) *Epistemology of Language*. Oxford: Oxford University Press.

____ 1997. *Contemporary Philosophy of Mind: A contentiously classical approach*. Malden: Blackwell Publishing.

Roberts, I. & Roussou, A. 2002. The History of the Future. In Lightfoot, D. (ed.) *Syntactic Effects of Morphological Change*. Oxford: Oxford University Press.

Rondal, J. A. 1994. Exceptional Cases of Language Development in Mental Retardation: The relative autonomy of language as a cognitive system. In Tages-Flusberg, H. (ed.) *Constraints on Language Acquisition: Studies of atypical children*. Hillsdale: Lawrence Erlbaum Associates.

Rorty, R. 1998. Davidson between Wittgenstein and Tarski. *Critica : revista hispanoamericana de filosophia*. 30 (88) : 49-71.

Rumelhart, D. E. & McClelland, J. L. 1987. Learning the Past Tenses of English Verbs : Implicit rules or parallel distributed processing? In MacWhinney, B. (ed.) *Mechanisms of Language Acquistion*. Hillsdale: Lawrence Erlbaum Associates.

Saffran, J. R., Aslin, R. N. & Newport, E. L. 1999. Statistical Learning by 8-month-old infants. *Science* 274:1926-1928.

Salmon, N. 1998. Nonexistence. *Nous* 32 (3): 277-319.

____ 1986. *Frege's Puzzle*. Cambridge: MIT Press.

Samuels, R. 2002. Nativism in Cognitive Science. *Mind and Language* 17 (3): 223-265

____ 2000. Massively Modular Minds: Evolutionary psychology and cognitive architecture. In Carruthers, P. & Chamberlain, A. (eds.) *Evolution and the Human Mind: Modularity, language and meta-cognition*. Cambridge: Cambridge University Press.

Sapir, E. 1985. *Selected writings of Edward Sapir in language, culture and personality*. Mandelbaum, D. (ed.) Berkeley: University of California Press.

Sartre, J. P. 1943. *L'être et le néant*. Paris: Gallimard.

Saxton, M. 1997. The Contrast Theory of Negative Input. *Journal of Child Language* 24 (1): 139-161.

Saxton, M., Culcsar, B., Marshall, G. & Rupra, M. 1998. Longer-Term Effects of Corrective Input: An Experimental Approach. *Journal of Child Language* 25 (3): 701-721.

Schieffelin, B. B. 1985. The acquisition of Kaluli. In *The crosslinguistic study of language acquisition*, vol. 1, Slobin, D. (ed.) Hillsdale, NJ: Lawrence Erlbaum Associates.

Searle, J. R. 2004. *Mind: A brief introduction*. Oxford: Oxford University Press.

____ 2002. Sneaked or Snuck. *The New York Review of Books* (March 14).

____ 2002. End of the Revolution. *The New York Review of Books* (February 28).

____ 1998. *The Rediscovery of the Mind*. Cambridge: MIT Press.

Segal, G. M. 2000. *A Slim Book about Narrow Content*. Cambridge: MIT Press.

Sellars, W. 1963. *Science, Perception and Reality*. London: Routledge & Kegan Paul.

Senghas, A. & Coppola, M. 2001. Children Creating Language: How Nicaraguan sign language acquired a spatial grammar. *Psychological Science* 12 (4) : 323-328.

Seymour, M. 2005. *L'Institution du Langage* Montreal: Les Presses de l'Université de Montréal.

Shanker, S. 1996. The Conflict Between Wittgenstein and Quine on the Nature of Language and Cognition and its Implications for Contraint Theory. . In Arrington, R. L. & Glock, H.-J. (eds.) *Wittgenstein and Quine*. Oxford: Routledge.

Shillcock, R., Lindsey, G., Levy, J. & Chater, N. 1992. A Phonologically Motivated Input Representation for the Modelling of Auditory Word Perception in Continuous Speech. In *Proceedings of the 14th Annual Conference of the Cognitive Science Society*. Hillsdale: Lawrence Erlbaum Associates.

Sieratzki, J. S. & Woll, B. 2002. Toddling into Language: precocious language development in motor-impaired children with spinal muscular atrophy. *Lingua* 112: 423-433.

Sluga, H. & Stern, D. G. (eds.) 1996. *The Cambridge Companion to Wittgenstein*. Cambridge: Cambridge University Press.

Smith, N. 2002. *Language, Bananas and Bonobos: Linguistic problems, puzzles and polemics*. Malden: Blackwell Publishing.

____ 1999. *Chomsky: Ideas and ideals*. Cambridge: Cambridge University Press.

Smith, N. & Tsimpli, I-M. 1991. Linguistic Modularity? A case study of 'Savant' linguist. *Lingua* 84: 315-351.

Smith, N., Tsimpli, I-M. & Ouhalla, J. 1993. Learning the Impossible: The acquisition of possible and impossible languages by a polyglot *savant*. *Lingua* 91: 279-347.

Soames, S. 1984. Linguistics and Psychology. *Linguistics and Philosophy* 7 (2): 155-179.

Sober, E. 2000. *Philosophy of Biology*. Boulder: Westview Press.

Spelke, E., Breinlinger, K., Macomber, J. & Jacobson, K. 1992. Origins of Knowledge. *Psychological Review* 99 (4): 605-632.

Stanley, J. & Williamson, T. 2001. Knowing How. *The Journal of Philosophy* 98 (8), 411-444.

Stone, T. & Davies, M. 2002. Chomsky Amongst the Philosophers. *Mind and Language* 17 (3): 276-289.

Stromswold, K. 2001. The Heritability of Language: A review and metaanalysis of twin, adoption, and linkage studies. *Language* 77 (4): 647-723.

____ 1994. What a mute child tells us about language acquisition. Unpublished manuscript. Center for Cognitive Science: Rutgers University.

Tages-Flusberg, H. (ed.) 1994 (a). *Constraints on Language Acquisition: Studies of atypical children*. Hillsdale: Lawrence Erlbaum Associates.

Tages-Flusberg, H. 1994 (b). Dissociations in Form and Function in the Acquisition of Language by Autistic Children. In Tages-Flusberg, H. (ed.) *Constraints on Language Acquisition: Studies of atypical children*. Hillsdale: Lawrence Erlbaum Associates.

Thornton, R. 1996. Elicited production. In Cairns, H., McDaniel, D. & McKee, C. (eds.) *Methods for Assessing Children's Syntax*. Cambridge: MIT Press.

____ 1990. Adventures in Long-Distance Moving: The Acquisition of Complex Wh-Questions. Unpublished Ph.D. Dissertation. The University of Connecticut, Storrs.

Tsimpli, I-A. & Smith, N. 1999. Modules and Quasi-Modules Language and Theory of Mind in a Polyglot Savant. *Learning and Individual Differences* 10 (3): 193-215.

Tomasello, M. 2000. Do Young Children have Adult Syntactic Competence? *Cognition* 74: 209-253.

Tomblin, J. B. 1997. Epidemiology of Specific Language Impairment. In Gopnik, M. (ed.) *The Inheritance and Innateness of Grammars*. Oxford: Oxford University Press.

Thompson, D. A. 1917. *On Growth and Form*. Cambridge: Cambridge University Press.

Turing, A. M. 1952. The Chemical Basis of Morphogenesis. *Philosophical Transactions of the Royal Society of London* Series B, Biological Sciences, 237 (641): 37-72.

Van der Lely, H. K. J. 1997. Language and Cognitive Development in a Grammatical SLI Boy: Modularity and Innateness. *Journal of Neurolinguistics* 10 (2/3): 75-107.

Voltolini, A. 2001. Why the Computational Account of Rule-following Cannot Rule out the Grammatical Account. *European Journal of Philosophy* 9 (1): 82-104.

Vygotsky, L. S. 1967. *Thought and Language*. Cambridge: MIT Press.

Waddington, C. H. 1942. Canalization of development and the inheritance of acquired characters. *Nature* 150: 563-565.

Wexler, K. 1991. On the Argument from the Poverty of the Stimulus. In Kasher, A. (ed.) *The Chomskyan Turn*. Malden: Blackwell Publishing.

Wittgenstein, L. 2000. *Philosophical Investigations*. Malden: Blackwell Publishing.

____ 1993. *Last Writings on the Philosophy of Psychology* (volume II). Malden: Blackwell Publishing.

____ 1989. *Notes sur l'Expérience Privée et les "Sense Data"*. Editions Trans-Europ-Repress.

____ 1989. *Remarques sur la Philosophie de la Psychologie* (volume I). Editions Trans-Europ-Repress.

____ 1985. *Tractatus Logico-Philosophicus*. London: Routledge & Kegan Paul.

Yang, C. 2003. *Knowledge and Learning in Natural Language*. Oxford: Oxford University Press.