A DEVELOPMENTAL STUDY OF CHILDREN'S ABILITY TO ACQUIRE KNOWLEDGE OF SPELLING PATTERNS

by

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The Acquisition of Knowledge of Spelling Patterns

ABSTRACT

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The ability to abstract two types of spelling patterns, morphological and orthographic, was studied by means of a multiple-choice test of nonsense words, a multiple-choice test of real words and a dictation test of nonsense words. These tests were administered to 160 children, 20 good and 20 poor spellers at each grade level from two to five. Both groups of spellers showed clear developmental trends in their ability to abstract morphological and orthographic patterns on all three tests. The good spellers were consistently better than the poor spellers, who lagged behind the good spellers in the acquisition of spelling patterns by about two years. Good spellers performed better on orthographic patterns than on morphological patterns, while the reverse was true for the poor spellers on the two tests using nonsense words. The findings demonstrate that pattern abstraction is part of the acquisition of spelling.

RESUME

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Etude du développement de l'habileté de l'enfant à acquérir la connaissance des "patterns" d'épellation

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L'habileté d'abstraction de deux types de "patterns" d'épellation, morphologique et orthographique, a été étudiée au moyen de tests à choix multiple de mots non-significatifs et de mots réels, et au moyen d'un test comprenant la dictée de mots non-significatifs. Ces tests ont été présentés à 160 enfants divisés en deux groupes: un groupe dont l'orthographe était bonne et un groupe dont l'orthographe était pauvre. Chaque groupe se composait de 20 enfants venant de tous les niveaux scolaires compris entre la deuxième et cinquième année. Les deux groupes ont montré clairement une tendance à développer leur habileté d'abstraction des "patterns" morphologiques et orthographiques dans les trois tests. Le groupe dont l'orthographe était bonne, était toujours meilleur que le groupe dont l'orthographe était pauvre. Ce dernier groupe était en retard d'environs deux ans dans l'acquisition des "patterns" d'épellation. De plus, le groupe dont l'orthographe était bonne avait des meilleurs résultats au niveau des "patterns" orthographiques que morphologiques, alors que le groupe dont l'orthographe était pauvre avait des résultats inverses dans les deux tests utilisant des mots non-significatifs. Ces résultats indiquent que l'abstraction de "patterns" fait partie de l'acquisition de l'épellation.

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NOTATIONAL CONVENTIONS

ə	schwa as in about
č	as in church
š	as in short
ž	as in garage
ǰ	as in judge
l!	as in bottle
m!	as in bottom
n!	as in cotton
s	underlining indicates orthographic symbol
/s/	single slash indicates phonemic level
//s//	double slash indicates morphophonemic level
→	corresponds to
v̄	long or free vowel
v̆	short or checked vowel
C	consonant
V	vowel

INTRODUCTION

Nearly everyone learns to spell. Exactly how this is accomplished is not known. Learning how to spell is not merely memorizing the sequences of letters in words or storing a series of visual images or templates. The fact that children can spell nonsense words and words that they have never seen before would suggest that the ability to spell must involve a knowledge of some system of rules. Since many of these rules are not formally taught and spellers are not consciously aware of them, learning to spell must, at least in part, involve the implicit abstraction of a set of rules that characterize the spelling system. Aside from curiosity about the development of this important human skill, a more pressing reason for wanting to understand the spelling process is to help children who fail to learn to spell.

For many years spelling and the English writing system were ignored by linguists and psychologists. Recently, because of increased interest in the reading process, a radically new look has been taken at how the English spelling system functions. Venezky (1967) found that English spelling is more complex and contains a higher degree of patterning than was ever assumed before. The English orthographic system has of late become a valid and respectable field of linguistic research. However, little significant linguistic research has been carried out related to the speller and the spelling process. The child as speller has not generated the same interest as the child as reader.

Aside from this general paucity of interest, or perhaps because of it, there are other factors hampering progress in the understanding of the spelling process. A thorough description and analysis of English orthography in relation to the spelling process is needed, of the type which has been carried out for the reading process (Venezky, 1967). In the last ten years there have been many attempts to formulate a theory of spelling. What is required, however, is a theory of literacy which is concerned with both the process of learning to read and the process of learning to spell, and which puts both in proper perspective. Finally, as yet we know little about children's strategies in learning to spell. The present research is related particularly to the last of these three considerations.

Historical Background

English orthography began as a system largely isomorphic with the phonological system. Until the 15th Century the writing system had sufficient flexibility to adjust to changes in the phonological system. A good fit was maintained despite many borrowings from other languages. There was also a fairly liberal attitude toward individual spelling idiosyncracies. The invention of the printing press, along with a general demand for standardization of the spelling system, brought an end to this flexibility, so that the English writing system has been maintained more or less unchanged for the past 400 years. Since the spoken system has continued to change, the two systems have moved farther and farther apart (Francis, 1965). The

disparity between the two systems has given rise to much discontent and desire for change. In the 16th Century, John Hart, a spelling reformer, referred to the "vices and faults of our writing system which cause it to be tedious and long in learning" (Danielson, 1955), and which Zachrisson (1930) described as being "antiquated, inconsistent and illogical".

There have been many attempts to reform the spelling system during the past 400 years, beginning with 17th Century grammarians. Spelling reformers were generally concerned about the lack of correspondence between sounds and letters, pointing out that an alphabet of only 26 letters could in no way hope to serve a phonology of 40 or so phonemes. They essentially wanted a one-to-one correspondence between the written and spoken language systems. They viewed writing as mirroring speech and indeed somewhat subservient to it, and expected that it should and ought to be perfectly phonetic. I. J. Pitman (1961), the most recent advocate of spelling reform, used an alphabet modified to be more phonemic for the purpose of teaching reading. Venezky (1970), who has written an extensive review of the various attitudes toward English orthography, commented on the evangelistic and moralistic quality that pervades much of the early writing. He pointed out that the spelling reformers seldom analyzed the object of their scorn beyond a concern with direct letter-to-sound relationship and ignored other, and more important, aspects of the writing system.

Current Views of the Orthography

In contrast to the early clamor for spelling reform, linguists, psychologists, and even the occasional educator have more recently been singing the praises of the English spelling system. Chomsky and Halle (1968) went so far as to say that it is an optimal system. The claim that English spelling is irregular, which pervaded much of the early writings, assumed that regularity in spelling involved predictability on a phonetic basis alone. Recent investigations of the orthography have indicated that the controlling rules and principles of the system lie deeper in the language than in the surface phonology (Venezky, 1967). Linguists now claim that English spelling is regular without being phonetic (Brengleman, 1970; Chomsky, 1970; Chomsky and Halle, 1968; Francis, 1958; MacKay, Thompson and Schaub, 1971; Venezky, 1967).

Francis (1958) was one of the first to point out that English orthography uses a complicated system of markers to compensate for its deficiencies in direct grapheme-phoneme correspondence. Markers are letters or letter sequences which, although sometimes having no sound equivalent themselves, indicate the phonemic reference of other letters in their environment.

In the spelling of the base form of a word there is still a fairly consistent phoneme-grapheme correspondence, providing one accepts the rationale of a system where position, environment and markers allow the same symbol to perform different functions and where several symbols represent the same sound. The spelling of compounds and derivatives (words derived from the base form) tends to be based on morphemic

considerations. In such cases phonetic variations introduced by phonological rules are ignored by the conventional orthography. Each morpheme is spelled in a uniform fashion even though it may be pronounced in several ways. For example, in medicine, medical and medicinal, the form medic remains the same, yet it has three different pronunciations. The change in pronunciation does not have to be noted in the orthography because the reader already knows the phonemic alternations that accompany derivational morphemes. Grammatical affixes, such as plurals -(e)s and past tense -ed remain visually constant although each has three different sound correspondences; e.g. -(e)s ⟶ /s/ (cups), /z/ (boys), /əz/ (watches); -ed ⟶ /t/ (walked), /d/ (judged), /əd/ (loaded); (Venezky, 1970).

If English were to be modified to a system where there was a one-to-one relationship between phoneme and grapheme, such as exists in the International Phonetic Alphabet (IPA), these morphological relationships would be lost. Related words could no longer be clustered together in the dictionary. Furthermore, if English orthography corresponded exactly to the phonology, it would not be understood all over the English speaking world, since there is much variation in spoken English. There would have to be as many different systems of writing as there are spoken dialects. Except for minor alternate spellings, the writing system is one part of the language which is uniform wherever English is used. These considerations are no doubt a large part of the reason why the various proposed changes have never achieved universal acceptance.

Teaching Methods

The teaching of spelling has been, and continues to be, influenced by the prevailing attitude toward the degree of regularity in phoneme-grapheme correspondence. In the first half of the 20th Century the Generalization Controversy raged in educational journals. The issue revolved around what to teach or how to present material to the budding speller. One side felt that there were regularities in the spelling system and that these should be exploited in the form of teaching the applicable rules. The type of rule taught was "final e makes the vowel long" or "when two vowels go walking, the first one does the talking". The opposing group felt that there were no useful or efficient rules and that one had to teach each word as an entity unto itself, so that a spelling lesson might simply be organized around a particular subject (Yee, 1966).

Unfortunately, spelling programs that subscribe to teaching according to rules are fraught with misconceptions and confusions. Many of the so-called rules taught are more related to decoding (spelling-to-sound) than to encoding (sound-to-spelling). The patterns taught are not linguistically sound and often there are as many exceptions to the rules as there are exemplars (e.g. "i before e except after c ...").

The difficulty with programs that teach spelling as if there were no logical connection between words is that they seem to put a tremendous burden on the memory of the learner and make it unnecessarily difficult for the beginning speller. Children are given lists of words to learn. Each word is attacked as an independent unit to be learned by rote. The phoneme-grapheme relationship is neglected or ignored.

In the past few years new programs have been introduced which claim to be linguistically based. They have not as yet reached too wide a population. Words are presented in families, e.g. cat, mat, fat, the purpose being to encourage the child to induce the sound-symbol regularity without any rules being stated. Words and Patterns by Day and Lightbody (1971) is one of the best of the newer series. The patterns taught in Day and Lightbody were abstracted from Venezky's work (Cronnell, 1971b). None of the three approaches to the teaching of spelling was based on research. Of the three, the 'linguistic' approach seems to be the most promising.

Differences Between Reading and Spelling

The predominant opinion among educators is that the spelling and reading processes are closely allied. It has traditionally been believed that the skills and abilities for one are those necessary for the other. Educational philosophy has by and large suggested teaching the two skills in an interrelated way. Barring any special learning difficulty, most children learn to read and spell at about the same time. However, children with learning disabilities often have a great deal more difficulty learning to spell than learning to read, and many never come close to mastering the spelling system even though they have achieved success with reading. This suggests that although there are undeniable similarities between reading and spelling, there are also intrinsic differences in acquisition and performance of reading and spelling skills.

Most linguists and psycholinguists do believe that reading and

spelling are different and of the two, spelling is the more difficult and complex process. Those who have most clearly delineated the two processes and pointed out considerable differences between spelling and reading are Brengleman (1970), Cronnell (1971a), Fries (1963), Peters (1967), Rogers (1967), Smith (1973) and Venezky (1969).

The question of similarities and differences in reading and spelling has important implications for teaching. One of the main tenets of the Stanford University Initial Reading Program (Rogers, 1967) is that reading and spelling should be taught independently. In discussing the two processes, Rogers points out that particular difficulties in reading are usually quite different than those associated with spelling. Words containing letters with no sound equivalent, e.g. lamb, thumb, and those with unstressed vowels, e.g. carrot, merit, present difficulty for the speller, but offer no particular problem for the reader. In the first instance English does not permit final -/mb/ clusters and speakers of English normally favor final -/m/ instead, and in the second instance, vowels in unstressed syllables are rendered consistently as schwa (/ə/) in reading. Similarly, double consonants are no problem for the reader, yet they are for the speller. On the other hand, the two sound correspondences for th may prove difficult for the reader, but not for the speller. Rogers also notes that the important cues for word recognition are mainly consonants, while the important cues for word spelling are primarily vowels. He believes that without specific and independent instruction in spelling, generalizations from appropriate symbol-sound correspondences to inappropriate sound-symbol correspondences might easily take place.

Cronnell (1971a) points out that the written symbols for reading are concrete and fairly easy to describe as physical units, while the stimuli for spelling, speech sounds or words, are more transient. Sounds cannot be isolated or described with the same precision as letters (Liberman, Cooper, Shankweiler, Studdert-Kennedy, 1967). Children learn earlier to discriminate between most letters than to analyze words into their component sounds (Liberman, Shankweiler, Carter, Fisher, 1972).

While there are only 26 letters in the English alphabet, there are considerably more spelling units operating when letter combinations are considered, 59 according to Venezky (1967) and 69 according to Berdiansky, Cronnell and Koehler (1969). There are approximately 40 distinctive sounds in English. Thus, reading tends to go from multiple stimuli to fewer responses (e.g. j, dge, ge ⟶ /j̆/). Spelling goes from a smaller set of stimuli to a larger set (e.g. /č/⟶ ch, tch, t).

According to Smith (1973) there are differences in both skills and knowledge employed in fluent reading and spelling, as well as differences in the learning processes. He contends that the alphabetic nature of our orthography makes quite different demands on memory and information processing capacities for spelling and reading, and that anything tending to make writing easier will make reading more difficult and vice versa. The orthography is a compromise between catering to the needs of the reader and those of the speller. He feels that the reader has the distinct advantage in that the recognition responses required for reading are easier than the reproduction responses required in spelling. One does not automatically remember and reconstruct the form of a word as easily as one can recognise it when it is correctly printed on the

page before one. According to transformational grammarians, for the reader the direction of information processing goes from the surface structure of the written symbol to the deep structure of meaning, while for the writer it works in the opposite direction. The reader can take advantage of orthographic, syntactic and semantic redundancy and thus need not identify every word or indeed even know the meaning of every word. The writer has far more rigid constraints. Variation is not permitted in spelling. "By and large, then, the nature of written communication would appear to be intrinsically more demanding for the writer than for the reader." (Smith, 1973, p.120).

Smith also believes that the knowledge acquired as a reader is not helpful when trying to spell a new word. Supposedly the visual feature list stored for reading does not have sufficient detail for spelling.

Finally, another basic difference between reading and spelling relates to their function or purpose. Reading is done primarily to gain meaning from print. Spelling is an encoding process intermediate to the expression of meaning in print.

Review of Relevant Literature

This section will review and discuss the studies systematically investigating the degree of regularity in phoneme-grapheme correspondence (Hanna and Moore, 1953; Hanna, Hanna, Hodges, Rudorf, 1966), the major study investigating grapheme-phoneme correspondence (Venezky, 1963) and several studies related to children's ability to abstract regularity in the orthography.

Hanna. Aside from an early study by Hanna and Moore (1953), the 1966 study by Hanna et al. is the only one that has investigated the sound-symbol correspondence from the point of view of spelling. In the earlier study Hanna and Moore sought to discover whether the orthography was regular enough to warrant teaching spelling by rule. They analyzed 3,000 of the most frequently used words in children's writing in terms of phoneme-grapheme correspondence. The relative frequency of correspondence was noted. The most frequent correspondence was classified as being regular, all others as irregular. The study revealed that phonemes were regularly represented by certain graphemes approximately 80% of the time, e.g. /p/ is almost always spelled p (pit, spot, top) regardless of where it occurs in a word. These findings were widely challenged, mostly on the grounds of their being based on too narrow a sample, the assumption being that if a larger sample of words were examined the 80% regularity of correspondence would not hold up (Horn, 1957).

With the help of computer technology a much larger sample of words was undertaken by Hanna, Hanna, Hodges and Rudorf (1966). The consistency of phoneme-grapheme correspondence in 17,000 words was studied. This time the effect of stress and position on the correspondence was taken into account. For example, /f/ is normally spelled f in the initial position of a syllable (form), ff when it terminates a word (stiff) and ph when it is the second element in a consonant cluster (sphinx). Stress sometimes affects the pronunciation of phonemes while the spelling remains constant (civ' il vs. civil' ian) and sometimes stress may change the spelling, but not the sound (at' tic vs. attack').

In terms of simple phoneme-grapheme correspondence it was again found that the great majority of consonants and a small number of vowels had single spellings more than 80% of the time. Position was found to have a more decided effect than stress on the consistency of phoneme-grapheme correspondence.

In another phase of the project, on the basis of the phoneme-grapheme rules derived by December 1964, a computer was programmed to spell the 17,000 words. Eighty-nine percent of the individual phonemes and 50% of the words were encoded correctly, e.g. /b/ was spelled b as in boy 2,237/2,283 or 98% of the times it occurred. They concluded that a sufficient segment of American English orthography is determined by a set of rules for phoneme-grapheme correspondence to warrant their exploitation in the teaching of spelling (Hodges and Rudorf, 1965).

The study was criticized for its use of a stilted kind of pronunciation (the New Collegiate Dictionary) that tends to give a higher degree of correspondence than is warranted. Another criticism was related to the emphasis placed on the 80% criterion for individual phonemes (Roberts, 1967). It is somewhat misleading. If words were composed of four phonemes, one could expect to spell less than 42% ($.8^4$) of them correctly (Venezky, 1969).

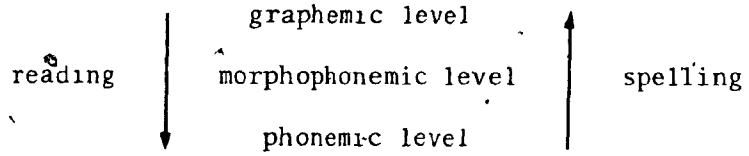
The major drawback of Hanna's research is that it was devoted almost solely to phonological considerations. A description of phoneme-grapheme correspondences that disregards morphological factors is inadequate since they are an important determiner of this relationship.

Venezky. The most complete and detailed analysis of English orthography was carried out by Venezky (1963). He wrote a computer

program to derive and tabulate spelling-to-sound correspondences in the 20,000 most common English words, based upon the position of consonant and vowel clusters within the printed word. For any continuous string of vowels or consonants in a written word, all pronunciations for that string, along with the total occurrence of that string and the percentages of occurrence for each pronunciation in each word position (initial, medial and final) were tabulated. There were complete word lists for each correspondence found. For example, the word list for gh$\longrightarrow$/g/ contained all of the words in the corpus for this correspondence, arranged into separate, alphabetized lists for the three word positions. He then analyzed these correspondences in their various orthographic environments to determine the type of relationship that they represented. He carried out the same tabulation of spelling-to-sound correspondences and formulation of word lists for the 5,000 most common words in the corpus and for the words of one syllable. He also compiled a dictionary of the corpus in which spellings were reversed and alphabetized in order to study suffixes and other word endings.

Using information from this study, Venezky (1967; 1970) and Venezky and Weir (1968) developed a model for mapping from spelling into sound and explaining the general patterns of the orthography. Venezky demonstrated that written English, though rooted in a phonemic base, is influenced by both morphemic and phonemic factors. He clearly indicated the tendency, pointed out by Francis (1958), to preserve the spelling of the base word despite variation in sound (e.g. sign, signal, signature) and described the morphemic markers (noun plurals, past tense and the possessive), the spellings of which also remain constant despite phonemic variation.

To account for both the phonemic and morphemic character of the orthography, Venezky postulated an intermediate level (the morphophonemic level) between spelling and sound:



He also described two types of correspondences acting as intermediaries to this morphophonemic level. The correspondence rules operating between the graphemic and morphophonemic levels are related to the internal structure of the orthography, the workable units (graphemes) and permissible sequences of these units in words. The second set of correspondences, operating between the morphophonemic level and the phonemic level, are dependent on syntactical and phonological patterns. The child entering school is presumed to know many of the second set of patterns (Berko, 1958) and must learn to relate them to the orthographic stimuli. For example, boys would first be broken into //b// //oy// //s//. Phonologically dependent patterns determine that //s// will be pronounced as /z/, hence /bɔiz/.

graphemic level	b o y s
morphophonemic level	//b// //oy// //s//
phonemic level	/b ɔi z/

According to Venezky the units which must be manipulated to relate spelling to sound are not just single letters, but letters and

combinations which act as a single unit (e.g. th, sh, wh) and which he refers to as relational units. The major relational units are vowels, which are divided into primary (e.g. a, e, i) and secondary groups (e.g. ea, ai/ay, oo, oi) and consonants which are divided into simple (e.g. c, t, sh) and compound groups (e.g. ck, tch, x), as illustrated in Table 1.

Besides the relational units, the graphemic level is also comprised of markers. They are defined as clusters of one or more graphemes which have no phonemic representation and whose primary function is to indicate the correspondence of other relational units (e.g. in mate, e acts as a marker to indicate the long vowel correspondence for a and to distinguish it from mat), or to preserve a graphotactical pattern (e.g. in love, e is added to preserve a pattern which does not permit final v), or a morphological pattern (e.g. in mouse, e indicates that the s is not a plural or third person singular). A relational unit sometimes performs a marking function as well (e.g. in cake, a indicates the hard correspondence of c, c $\longrightarrow$ /k/). A double consonant (geminate consonant cluster) also performs a marking function since it regularly indicates the correspondence of the preceding vowel (e.g. biding vs. bidding, siting vs. sitting, raked vs. racked, coma vs. comma).

For each relational unit, Venezky (1970) has described 1) its occurrences in different positions of the word, 2) its sound correspondences, and 3) its alternations, predictable sound and letter variations according to the graphemic environment. For example, s 1) occurs in initial, medial and final position by itself, in a large number of initial consonant clusters and in four final clusters. 2) The correspondences for initial and final s are fairly regular, those for medial s

TABLE 1

Major and minor relational units (from Venezky, 1970).

Consonants							Vowels			
Simple					Compound		Primary	Secondary		
Major Relational Units										
b	gh	n	s	w	ck		a	aɪ/ay	ɪe	ue
c	h	p	sh	y	dg		e	au/aw	oà	ui
ch	j	ph	t	z	tch		i	ea	oe	
d	k	q	th		wh		o	ee	oi/oy	
f	l	r	u		x		u	eɪ/ey	oo	
g	m	rh	v				y	eu/ew	ou/ow	
Minor Relational Units										
	kh				gn				ae	
	sch								eau	
									eo	
									uy	

are highly irregular and are not readily predictable, i.e. initial s corresponds to /s/, final s after a voiced consonant spelling and in as, has, his, is, was corresponds to /z/. 3) The alternation of morphemic s between /s/ and /z/ is quite predictable. After /s, z, š, ž, č, ǰ/, final morphemic s becomes /-Iz/; after any other voiced phoneme, it becomes /z/; otherwise it remains as /s/.

Venezky classifies spelling patterns as predictable or unpredictable. In the predictable category are those patterns which can be predicted on the basis of regular graphemic, morphemic or phonemic features of the words or sentences in which they occur. Predictable patterns are classified as invariant or variant. Invariant patterns have no or very few exceptions. They assign the same sound to a particular spelling regardless of its environment, e.g. for reading f ⟶ /f/ (except in of), m ⟶ /m/, and for spelling /ð/ and /θ/ are almost always spelled th. Variant patterns have predictable variations or alternatives. They relate the same spelling to two or more pronunciations depending upon regular graphemic, phonological or grammatic features, e.g. for reading c corresponds to /s/ when it occurs before e, i, or y plus a consonant or juncture, but to /k/ in most other positions, and for spelling final /č/ is either ch or tch, with tch occurring after a short vowel which is spelled with a single letter and ch occurring in all other circumstances including vowel + r (except for much, such, rich and which).

All other patterns are classified as unpredictable. In this category there are three classifications: 1) High-frequency patterns which occur frequently enough to allow an association group to be

profitably employed in teaching (e.g. motion, portion, nation); 2) Low-frequency patterns which occur too infrequently to merit the formation of an association group (e.g. toe, hoe, foe), and 3) Affix-aided patterns which could be derived by relating the word to one of its prefixed or suffixed forms (e.g. the spelling of sign could be predicted if one knew the form signal).

Venezky objects to the terms "regular" and "irregular" for classifying spelling patterns. "Regular" is commonly defined as the most frequently-occurring correspondence which merges predictable patterns with unpredictable patterns and fails to consider whether the variable spellings are predictable or not.

For teaching purposes Venezky set up a three-fold classification for words to be read and spelled: 1) Transfer words are those which contain predictable patterns that can be transferred to the pronunciation or spelling of other words with similar patterns, 2) Association words are grouped according to frequently-occurring, but unpredictable patterns that cannot be transferred to other words, and 3) Isolated words are those which should be handled as whole words to inhibit incorrect transfer of unpredictable, low-frequency patterns.

Venezky's model applies to the reading process going from spelling to sound, while the spelling process involves going from sound to spelling. The correspondences or patterns for spelling are not a simple reversal of those involved in the reading process. Those patterns related to spelling have not as yet been analyzed or described.

Studies concerning children's ability to abstract structure in the orthography. A search of the literature did not reveal any studies dealing with children's ability to abstract patterns as part of the spelling process. There are, however, a few studies indicating that good spellers have greater ability than poor spellers to make use of the redundancy in written language when reading. These studies utilize a reading-type task or visual memory task, rather than a spelling task.

Bruner (1957) referred to a study by William Hull in which pseudo-words were presented to good and poor fifth-grade spellers. After a brief exposure to the words the children were asked to write them down. Some of the pseudo-words were random strings of letters, others were third and fourth-order approximations to written words (Miller, Bruner and Postman, 1954) which reflected the sound structure of English. For the random sequences there was no difference between the good and poor spellers. With close approximations to English the good spellers showed a much superior performance. Hull concluded that the good spellers had somehow learned the general system.

Klein and Schneider (1960) compared good and poor spellers in the fifth and eighth grades on their ability to choose a member of a pair of nonsense words that looked most like a 'real' English word. Five-letter nonsense words representing four orders of approximation to English were constructed. In general, the good spellers were superior. The difference between the two groups was most apparent on choices of moderate difficulty.

Wallach (1963) reported on an experiment in which 55 fifth-grade students were tested for ease of perceptual recognition of nonsense words which resemble English, and nonsense words which do not. Groups

of good and poor spellers were equated for their recognition accuracy for the latter words. Good spellers were found to recognize nonsense words which resemble English more readily than poor spellers. On this basis he concluded that good spellers had learned a general coding system. He did not know whether it was based on the learning of a sequential probability structure of letters or phonetic generalization, or both.

McLeod (1967) tested good and poor spellers in the fourth grade on their ability to reproduce tachistoscopically presented letter sequences of different orders of approximation to English. Good spellers were superior to the poor spellers and their superiority increased as the letter sequences approximated more closely to English words. Poor spellers showed improvement as well when letter sequences approximated more closely to English, but not to the same extent as good spellers. He concluded that poor spellers do not appear to take as much advantage of the redundancy of printed English in reproducing letter sequences. All four studies were consistent in their findings that spelling ability is related to the ability to make use of orthographic redundancy.

Eleanor Gibson (1970) has postulated the existence of 'spelling patterns', higher order units formed by grapheme-phoneme correspondences. She has studied how these spelling patterns operate and are learned in the reading process. Her basic premises are that the search for invariance and the discovery of structure are basic forces in cognitive motivation.

Gibson, Pick, Osser and Hammond (1962) did tachistoscopic experiments with two kinds of letter strings, pronounceable and unpronounceable. The pronounceable ones began and ended with consonant

clusters permissible in English speech, which also map regularly to spelling in those positions, e.g. glurck. (This example, the one most frequently quoted in the literature, does not abide by the rules of English spelling since 'ck' never follows a consonant.) The unpronounceable control words were made by exchanging the initial and final consonant clusters, thus forming an unpermissible sequence of sounds or letters, e.g. ckurgl. Children perceived the pronounceable combinations of letters with greater ease than the unpronounceable sequences. They concluded that pronounceability of letter strings facilitates reading them because of the correspondence of component clusters of letters with units of speech.

Rosinski and Wheeler (1972) replicated the Gibson, Pick, Osser and Hammond experiment using simultaneous discrimination, rather than tachistoscopic recognition. The children had to decide which of two pseudo-words was more like a real word (e.g. glurck vs. ckurgl). They tested 48 children in Grades 1, 3 and 5. They found that by third grade children were able to use orthographic patterning to discriminate between nonsense words, but first-grade children made the judgement at chance level.

Gibson, Osser and Pick (1963) considered two possibilities as to how grapheme-phoneme correspondence rules are learned. Either the child begins by memorizing whole words and later learns to abstract some of the correspondence rules, or the correspondence rules are formulated as he learns to read. Children at the end of first grade were compared to children at the end of third grade in their ability to recognize (by spelling out) familiar three-letter words and both pronounceable and unpronounceable trigrams that were anagrams of the words (e.g. ran, nar, rna) presented tachistoscopically. The results showed that first-graders

of both sexes and third-grade boys read familiar words correctly with greatest frequency and that they read pronounceable trigrams more accurately than unpronounceable ones. The third-grade girls read all three letter combinations with high and equal frequency. Gibson interpreted these results as suggesting that a child in the first stage of reading acquisition typically reads in short units, but has already begun to perceive some regularity of correspondence between the printed and spoken words and transfers these to the reading of unfamiliar words.

The 1962 experiment was replicated with some modifications for comparison of deaf and hearing subjects (Gibson, Shurcliff and Yonas, 1966). The deaf subjects made significantly more errors than the hearing subjects. However, both groups of subjects were most successful in reading the pronounceable words. In the face of this evidence the pronounceability hypothesis had to be abandoned since invariant sound mapping was probably not readily available to the deaf subjects. They accounted for the difference between the two types of words by rules of orthography (spelling patterns). In answer to a suggestion that these spelling patterns were merely based on higher sequential probability of letters without regard to sound, results of the study were subjected to a multiple regression analysis in which several summed frequency counts were tested as predictors. Summed bigram and summed trigram counts did not predict success in reading the words when pronounceability was partialled out and length held constant. Gibson describes the spelling patterns as complex orthographic rules which cover structural patterns of letters permissible in English words. Such rules may be learned without necessarily being related to speech sounds. An example of such a rule would be that 'ck' may end a word, but never begin it.

There is, in short, a kind of grammar for letter sequences that generates the possible combinations.

Gibson, Farber and Shepela (1967) designed a learning set experiment to test how these spelling rules are learned. They hypothesized that there are invariant patterns over many variable contexts and that a learning set develops for finding regular patterns in the orthography. A number of problems were constructed that required the subject to sort positive from negative instances of a particular pattern or invariance. The patterns consisted of two letters in an invariant position, either initial, medial or final. The other letters always varied, e.g.

chop	team	song
chin	read	ring
chum	lean	bang

The subjects were kindergarten and first-grade children. The kindergarten children did not develop a learning set on five consecutive days, whereas half of the first-grade sample showed evidence of developing a learning set to abstract common patterns of orthography. In another experiment with first and third-grade children, they compared success on analogous problems using colour chips instead of letters. For the first-grade children, colour and letter patterns were equally difficult. If success occurred on the colour problems first, it transferred to the spelling patterns. For the third-graders, letter patterns were picked up much more easily and then transferred to the colour patterns. Gibson thought that the third-graders had learned to search actively for invariant spelling patterns, and that this was more than task-specific learning

since it had transferred to the colour problems. She concluded that a set to look for structure can be developed and can transfer to new problems, and that the ability to detect structure in letter patterns improves with age and schooling.

In another learning set experiment, Lowenstein (1969), a student of Gibson, compared three procedures with first-graders on a mail-sorting task. One group was given no special help as to the nature of the task. The second group was given special help. They were told that they would be able to find their own mail because all their cards would have two specific letters on them. These letters were pointed out. The third group was told that they would be able to find their own mail because all their cards would have the same two letters on them. They were not told which letters. After two days of practice they had a post-test set of problems using two new letters.

In the first two days the second group, with specific help, made very few errors, while the first group with no help made many errors, although some improvement did occur. The group given the general hint made many more errors to begin with than the children given specific help, but they improved steadily and on the post-test 60% made no errors. Only 20% of the subjects in the other two groups made no errors on the post-test.

Lowenstein concluded that first-grade children can sort words on the basis of presence or absence of two specific letters that have been pointed out to them, but this ability does not lead to the discovery of common spelling patterns across items. He believed that there must be a search for an invariant pattern and actual discovery of such structure in order for this kind of abstraction to be transferred to a new

problem. Those children whose attention was directed to search for invariant features in the stimulus array did clearly better than those who had specific help. He felt that the finding of invariants was reinforcing, leading to a repetition of a successful strategy.

Gibson and Guinet (1971) investigated the manner in which one form of morphological information, verb inflection, is processed in reading. They wanted to know whether the length of a word correctly perceived tachistoscopically could be increased by adding a well-known inflected ending to a base word, as compared to an uninflected word of the same length. Inflected endings (-s, -ed, -ing) were added to three types of base words: real familiar words, and pronounceable and unpronounceable pseudo-words that were anagrams of them. These words were compared with uninflected words of different lengths. Subjects were children in the third and fifth grades and college students. Inflections did not increase the length of the word that could be correctly perceived, but did tend to function as units. When they looked specifically at where the errors were, however, they found that there were significantly fewer errors in inflected endings than in endings of base words of equivalent length, particularly when the words were not meaningful or pronounceable. The errors in the inflected endings tended to be substitutes of other inflected endings, e.g. -ing for -ed. This ending substitution happened more frequently for the transformed words than for the non-transformed words and this tendency increased from third to fifth grade. These results were interpreted to mean that the endings, morphological inflections, operated as unitary features of the written word that must be processed. Because the subject had to process an extra feature, he was not able to perceive a longer word when the morphological

marker was added. This would suggest that the rate of information processing may be increased by sensitivity to morphological markers, even though the reading rate per word does not change.

Finally, Calfee, Venezky and Chapman (1969) thought that grapheme-phoneme generalizations should aid the reader in pronouncing or approximating the pronunciation of words that he had not seen before. They investigated the extent to which readers used letter-sound correspondences in pronouncing synthetic words and the manner in which they pronounced synthetic words without regular correspondences. The predictable patterns tested were final e, c before i and e, and c before a, o and u. They tested children in the third, sixth and eleventh grades and college students. Good readers were consistently more likely than poor readers to give appropriate responses to predictable patterns and agreed more consistently on a preferred pronunciation for the unpredictable patterns. They found that the good readers in Grade 3 showed some mastery of predictable letter-sound correspondences. This mastery increased through high-school, but the correlation with reading achievement decreased, presumably because this ability is only one of the many necessary for skilled reading. The youngest poor readers made more and wilder errors on predictable patterns and gave less consistent responses to unpredictable spelling.

The above research has shown that children in the early stages of reading begin to abstract the patterning or structure that exists in the orthography and are able to transfer it to the decoding of unfamiliar words. Gibson et al. (1963) believe that pattern abstraction or rule induction can be accomplished by the child with no explicit training

once he is exposed to the orthography. Assuming that the child is competent in hearing and speech at the time of school entry, an integral part of learning to read is abstracting the structure. Gibson notes four types of rules or structure; correspondence rules between the phonological and graphic systems, rules of orthography (written considerations of sound), grammatical constraints and meaning. She theorizes that perceptual learning of words involves the learning of distinctive features and higher-order invariants, with learning progressing actively toward the most economical sets of features and structure. Features of words are classified as phonological, graphic, orthographic, semantic, and syntactic. These are processed independently and sequentially in a hierarchical fashion. There is a developmental change with age and schooling in feature analysis and pick-up. The order of pick-up or word features changes with the task. Gibson suggests that the orthographic and syntactic rule systems do not operate fully as important constraints until later. The influence of orthographic structure begins to be quite apparent by Grade 3.

Present study. All of the above studies have suggested that children show knowledge of various features and rules in reading. The present research is aimed at studying how children learn to abstract and encode certain word features in spelling.

From Venezky's (1970) description of patterning related to the reading process, some orthographic and morphological patterns related to the spelling process were abstracted for use in this study. The patterns chosen are by no means an exhaustive list of the existing patterns. Orthographic and morphological patterns were chosen because they are the two classes of features best described by Venezky, and, if Gibson is

correct in stating that they develop somewhat later, it was hoped that a developmental trend might emerge.

Berko's classic study (1958) suggested a means of testing for knowledge of spelling patterns. She tested for knowledge of morphological rules using nonsense syllables. For example, she assumed that if a child can supply the correct plural ending to a made-up noun, he has internalized a working system of the plural allomorph /s/ in English, and is able to generalize to new cases and to select the right form. Following Berko's rationale, the decision was made to study children's ability to abstract spelling patterns by their ability to spell nonsense words. If a child is correctly able to spell 'boys' or 'matches', one does not know whether he has mastered the spelling of plurals or has simply learned two instances. If, however, he chooses or writes 'otches' for the plural of 'otch', there is evidence that he has internalized a rule for spelling one form of the plural and is able to generalize to new cases.

The study attempts to answer the following questions:

1. Do children, in fact, abstract and use patterns in the spelling process?
2. Is there a developmental change in their ability to do so?
3. Is the ability to abstract patterns a factor in spelling ability?

METHOD

Subjects

The subjects were students from three different schools in the Protestant School Board of Greater Montreal whose school population was predominantly English-speaking and in the middle income bracket. Criteria for selection were:

1. Intelligence within the range 90-120 on the Lorge-Thorndike Intelligence Tests, Level 2, Form B for Grades 2 and 3, and Level 3, Form A for Grades 4 and 5;
2. At least average academic achievement with no grade repeated since starting school, and currently making satisfactory progress;
3. No indication of specific learning problems;
4. No severe uncorrected visual or hearing problem, and
5. English as a native language.

A total of 249 children who met the above criteria were pre-tested on the Spelling subtest of the Durrell Analysis of Reading Difficulty, with 59 children in Grade 2 and 61 in Grade 3 tested on List 1, and 58 in Grade 4 and 64 in Grade 5 tested on List 2. At each grade level the 20 highest scorers were assigned to the Good Spellers group and the 20 lowest scorers were assigned to the Poor Spellers group, providing 40 subjects at each grade level for a total of 160 subjects. Sex, mean and range of age, IQ, and spelling scores on the Durrell Spelling Test for each group at each grade level are shown in Table 2.

TABLE 2

Mean and range of age, IQ, and spelling test scores and distribution of sex for 20 good (G) and 20 poor (P) spellers at each grade level from 2 to 5.

	Age (yrs. mos.)		Sex		Lorge-Thorndike IQ		Durrell Spelling Scores		Spelling
Grade	Mean	Range	Male	Female	Mean	Range	Mean	Range	Classification
2	7-6	7-1 - 8-0	10	10	101.1	90 - 115	1.2	0 - 2	P
2	7-7	7-2 - 8-2	10	10	106.5	91 - 119	12.8	9 - 17	G
3	8-6	8-1 - 9-1	10	10	100.2	93 - 116	8.7	3 - 12	P
3	8-5	8-0 - 9-0	8	12	107.3	97 - 120	16.9	16 - 18	G
4	9-6	9-1 - 10-7	13	7	106.3	91 - 117	3.8	1 - 5	P
4	9-5	9-0 - 10-0	12	8	114.4	96 - 120	11.8	9 - 18	G
5	10-7	9-8 - 11-6	14	6	96.4	90 - 110	9.0	2 - 12	P
5	10-6	10-1 - 11-0	7	13	108.8	91 - 119	17.3	16 - 19	G

Test Construction

As mentioned earlier, there has not as yet been a careful linguistic description and analysis of patterning in the process of going from sound to spelling. Hence, there is no body of recognized spelling patterns or rules which have a firm theoretical basis. What are claimed to be 'spelling rules' in spellers, spelling work-books, or texts on educational methods are essentially arbitrary judgements. Many of these books were perused in search of suitable spelling patterns for use in the present study, including Bannantyne and Cotterell (1966), Childs and Childs (1963), Cox (1971) and Gillingham and Stillman (1960). Some linguists interested in the orthography have also described patterns relevant to the spelling process (Dale, 1972; Klima, 1972; MacKay, Thompson and Schaub, 1971). With one exception, no pattern or rule noted in an educational source was selected for this study unless it also had been noted in a linguistic source. Most of the patterns finally selected were derived from Venezky's (1970) work on reading patterns. In construction of the multiple-choice tests, selection of the incorrect alternatives was in part based on the present writer's experience with the spelling errors of children.

Pilot studies with a preliminary set of items were conducted in Grades 2 and 5 and with university students. Some items were found to be poorly designed in that they contained competing patterns. (For example, the stimulus word was /mav/ and the choices were mave, mav and mavv. The graphotactic rule which forbids a final v conflicted with the pattern that e acts as a marker to indicate the 'long' vowel correspondence.) Such items were eliminated. The preliminary test was composed

of 46 items which included three types of patterns: regular phoneme-grapheme correspondences, those related to morphology, and those concerned with the internal structure of the orthography. It was decided for the purposes of this study to eliminate those patterns related to phoneme-grapheme correspondence and use only those related to morphology and the orthography. Thirty items, exemplifying two types of patterns, 13 relating to morphology and 17 relating to the internal structure of the orthography were selected for the final tests.

Five of the morphological items were related to the spelling of the plural. The plurality of nouns is marked in the writing system by (e)s. There are, however, three different phonetic realizations depending on the final sound of the word (/s/, /z/, /əz/). In each case the particular phonetic realization required by the context is predictable. There is no need to show the different phonetic realizations of the plural with different symbols, because the correct phonetic values will be assigned automatically by any native speaker through phonological rules that he has no choice but to apply. One item dealt with the spelling of the plural of a word ending in an unvoiced stop (/s/⟶ s), another dealt with the spelling of the plural of a word ending in a sibilant (/əz/⟶ es), a third item involved the spelling of the plural of a word ending in a voiced stop (/z/⟶ s), a fourth item dealt with the plural of a word ending in a long or free vowel, other than ī/aI/ (/z/⟶ s), and the fifth item dealt with the spelling of the plural of a word ending in long or free ī/aI/. Here there is an alternation of i and y on orthographic considerations and the use of es as the plural marker. References for these items are Bannantyne and Cotterell (1966), Childs and Childs (1963), Cox (1971), Dale (1972),

Day and Lightbody (1971), Klima (1972), MacKay, Thompson and Schaub (1971) and Venezky (1970).

Three of the morphological items were related to the spelling of the past tense. The past tense of verbs is marked by ed, but has three different phonetic realizations (/d/, /t/, /əd/), depending on the final sound of the word. In each case the phonetic realization is predictable and is assigned automatically by the native speaker. One item dealt with the spelling of the past tense of a word ending in a voiced consonant (/d/——→ ed), another dealt with the past tense of a verb ending in an alveolar stop (/əd/——→ ed), and the third item was concerned with the spelling of the past tense of a word that ends in an unvoiced consonant (/t/——→ ed). References for these items are Childs and Childs (1963), Cox (1971), Dale (1972), Day and Lightbody (1971), MacKay, Thompson and Schaub (1971) and Venezky (1970).

Two morphological items were concerned with the spelling of the singular and plural possessive. The singular possessive is regularly spelled 's and the plural possessive is spelled s'. References for these items are Childs and Childs (1963), Cox (1971), Day and Lightbody (1971), Klima (1972), MacKay, Thompson and Schaub (1971) and Venezky (1970).

Three morphological items dealt with the spelling of adjectives. The spelling of the comparative adjective is consistently represented as er. The spelling of the superlative adjective is marked by est. Final unstressed /I/ is consistently spelled y when the word is an adjective. References for these items are Childs and Childs (1963), Cox (1971), Cronnell (1971b) and Day and Lightbody (1971).

Ten orthographic items dealt with vowel correspondence. In

two of these, e acted as a marker to indicate the long vowel correspondence (/CV̄C/——→ CVCe). References for these items are Bannantyne and Cotterell (1966), Cox (1971), Cronnell (1971b), Day and Lightbody (1971), MacKay, Thompson and Schaub (1971) and Venezky (1970). In eight of the items, there was an alternation of a single and a double consonant to indicate vowel correspondence; a double consonant indicating a checked or short vowel, and a single consonant indicating a long or free vowel. In one item, tch was considered to function as a doubling of ch, and in another dg acted as a doubling of g- (Venezky, 1970). There was one item dealing with a polysyllabic word in which the doubling of the final consonant before a suffix beginning with a vowel depended on the final syllable being stressed. References for these items are Bannantyne and Cotterell (1966), Childs and Childs (1963), Cox (1971), Cronnell (1971b), Day and Lightbody (1971), MacKay, Thompson and Schaub (1971) and Venezky (1970).

Seven orthographic items dealt with consonant correspondence. In one item, e acted as a marker to indicate the 'soft' pronunciation of g/ǰ/, and in two items, e acted as a marker to indicate the 'soft' pronunciation of c/s/. Non-morphemic, final /s/ after a free vowel or /n/ is commonly spelled ce. References for these items are Bannantyne and Cotterell (1966), Cox (1971), Day and Lightbody (1971) and Venezky (1970).

One item was concerned with the spelling of initial /kw/ as qu. The letter q is never used alone, but is always followed by u, making a spelling unit qu. References for this item are Bannantyne and Cotterell (1966), Cox (1971), Day and Lightbody (1971) and Venezky (1970).

Three items dealt with the spelling of syllabic consonants. When l, m and n occur in English words at the end of a word after a

consonant they become syllabic. Most native speakers perceive a vowel before a syllabic liquid or nasal because they know that the peak of most syllables is a vowel and because it is usually represented in the spelling. The most common spelling for final /l!/ is le, and the most common spelling for final /m!/ is Vm (except after /θ/ or /z/, where it is m as in rhythm and schism). Syllabic /n!/ is spelled Vn. References for these items are Cox (1971), Cronnel (1971b), Day and Lightbody (1971), MacKay, Thompson and Schaub (1971), Read (1971) and Venezky (1970).

Tests

Three 30-item tests were constructed using the same morphological and orthographic sub-patterns. Tests 1 and 2 can be found in Appendix A. Test 1 is a multiple-choice test of nonsense words. The carrier phrase, choices and type of pattern and sub-pattern for each item are shown in Table 3. An explanation of the choices for Test 1 can be found in Appendix B. Test 2 is a multiple-choice test of English words containing the same patterns used in Test 1. The carrier phrase, choices and type of pattern and sub-pattern for each item are shown in Table 4. An attempt was made to choose very familiar words for Test 2. Of the 30 words chosen, 23 were from the most frequent 1,000 words, six from the most frequent 2,000 words and one from the most frequent 3,000 words (Thorndike and Lorge, 1944). Test 2 was designed in order to compare children's performance on nonsense words with that on real words. Test 3 is a test of nonsense words written from dictation. The carrier phrase and type of pattern and sub-pattern for each item are shown in Table 5.

TABLE 3

Carrier phrases and choices used in Test 1 (multiple-choice, nonsense words), with type of spelling pattern, morphological (M) or orthographic (O), indicated for each item. The correct choice is underlined.

	Carrier Phrase	Choices				Pattern and Sub-Pattern
1.	I have two ___.	fopse	fops	fopes	M	Pluralization
2.	Please give me three ___.	otchs	otchez	otches	M	Pluralization
3.	We saw five ___ on the bus.	ruds	rudz	rudes	M	Pluralization
4.	He needs ten ___.	flaze	flayes	flays	M	Pluralization
5.	I hit four ___.	smies	smys	smize	M	Pluralization
6.	Can you give me a ___.	liss	lis	lise	O	Vowel correspondence
7.	Please pass the ___.	zil	zill	zile	O	Vowel correspondence
8.	I will ___ it tonight.	hap	hayp	hape	O	Vowel correspondence
9.	Do you want to ___?	nike	nik	nyk	O	Vowel correspondence
10.	I have a wap that wears a hat. My ___ hat is blue.	waps'	waps	wap's	M	Singular possessive
11.	I had a wap. Now I have two of them. Both ___ hats are blue.	waps'	waps	wap's	M	Plural possessive
12.	That ___ is his.	quiff	qwiff	kwiff	O	Consonant correspondence
13.	We ___ to work this morning.	rallde	ralled	ralld	M	Past tense
14.	Yesterday he ___ his coat.	laddid	ladded	laddud	M	Past tense
15.	On Sunday we ___ in the park.	poshd	posht	poshed	M	Past tense
16.	The ___ is open.	bouge	bouj	boug	O	Consonant correspondence
17.	I like to ___.	voche	votch	voch	O	Vowel correspondence
18.	Where is my ___?	hoffl	hoffel	hoffle	O	Syllabic consonant
19.	Paint the ___ red.	bige	bij	bidge	O	Vowel correspondence
20.	The men were ___ on Friday.	engated	engatted	engaded	O	Vowel correspondence
21.	That ___ costs a dollar.	hatm	hattm	hattom	O	Syllabic consonant
22.	A ___ a day keeps the doctor away.	luddn	ludden	ludn	O	Syllabic consonant
23.	He is ___ his brother.	kabbing	kabeing	kabing	O	Vowel correspondence
24.	Let's go to the ___.	rance	ranc	rans	O	Consonant correspondence
25.	She has a good ___.	goys	goic	goice	O	Consonant correspondence
26.	It is a ___ day.	pendey	pendy	pende	M	Adjectival y.
27.	My boat is ___ than yours.	jister	jistir	jistr	M	Comparative
28.	This is the ___ book I ever read.	jankist	jankust	jankest	M	Superlative
29.	They will ___ the baby.	stiden	styden	stidden	O	Vowel correspondence
30.	They are ___ very slowly.	fiping	fipping	fipeing	O	Vowel correspondence

TABLE 4

Carrier phrases and choices used in Test 2 (multiple-choice, real words), with type of spelling pattern, morphological (M) or orthographic (O), indicated for each item. The correct choice is underlined.

	Carrier Phrase	Choices				Pattern and Sub-Pattern
1.	I have two ___.	topse	tops	topes	M	Pluralization
2.	Please give me three ___.	matchs	matchez	matches	M	Pluralization
3.	There are three ___ in my room.	beds	bedz	bedes	M	Pluralization
4.	I saw five ___.	plaze	playes	plays	M	Pluralization
5.	He hit four ___.	flies	flys	flize	M	Pluralization
6.	You gave me ___.	less	les	lese	O	Vowel correspondence
7.	He ___ be home soon.	wil	will	wile	O	Vowel correspondence
8.	What is your ___?	nam	naym	name	O	Vowel correspondence
9.	They ___ to watch TV.	like	lik	lyk	O	Vowel correspondence
10.	I have a cat that wears a hat. My ___ hat is blue.	cats'	cats	cat's	M	Singular possessive
11.	I had a cat. Now I have two of them. Both ___ hats are blue.	cats'	cats	cat's	M	Plural possessive
12.	This is ___ good.	quite	qwite	kwite	O	Consonant correspondence
13.	He ___ last night.	callde	called	calld	M	Past tense
14.	Yesterday he ___ his coat.	needid	needed	needud	M	Past tense
15.	On Sunday I ___ my hair.	washd	washt	washed	M	Past tense
16.	Tell me your ___.	age	aij	aig	O	Consonant correspondence
17.	Do your shoes ___?	mache	match	mach	O	Vowel correspondence
18.	She wants a ___ more.	littl	littel	little	O	Syllabic consonant
19.	Don't go near the ___.	ege	ej	edge	O	Vowel correspondence
20.	He ___ that he was late.	regreted	regretted	regreded	O	Vowel correspondence
21.	There is a hole in the ___.	botm	bottm	bottom	O	Syllabic consonant
22.	It happened all of a ___.	suddn	sudden	sudn	O	Syllabic consonant
23.	The baby is ___.	smilling	smileing	smiling	O	Vowel correspondence
24.	I brush my teeth ___ a day.	once	onc	ons	O	Consonant correspondence
25.	She has a good ___.	voys	voic	voice	O	Consonant correspondence
26.	It is a ___ beach.	sandey	sandy	sande	M	Adjectival y
27.	My boat is ___ than yours.	faster	fastir	fastr	M	Comparative
28.	He has the ___ hair.	shortist	shortust	shortest	M	Superlative
29.	They will ___ the road.	widen	wyden	widden	O	Vowel correspondence
30.	We are ___ for supper.	stoping	stopping	stopeing	O	Vowel correspondence

TABLE 5

Carrier phrases used in Test 3 (nonsense words written to dictation) with type of spelling pattern, morphological (M) or orthographic (O), indicated for each item. The stimulus word is underlined.

	Carrier Phrase	Pattern and Sub-Pattern	
1.	I have two hups.	M	Pluralization
2.	Please give me three ratches.	M	Pluralization
3.	We saw five fids on the bus.	M	Pluralization
4.	He needs ten drays.	M	Pluralization
5.	I hit four bries.	M	Pluralization
6.	Can you give me a tess?	O	Vowel correspondence
7.	Please pass the vill.	O	Vowel correspondence
8.	I will gabe it tonight.	O	Vowel correspondence
9.	Do you want to vike?	O	Vowel correspondence
10.	I have a rad that wears a hat. My rad's hat is blue.	M	Singular possessive
11.	I had a rad, but now I have two of them. Both rads' hats are blue.	M	Plural possessive
12.	That quab is his.	O	Consonant correspondence.
13.	We lebbed to work this morning.	M	Past tense
14.	Yesterday he joded his coat.	M	Past tense
15.	Last Sunday we mished in the park.	M	Past tense
16.	The nage is open.	O	Consonant correspondence
17.	I like to hotch.	O	Vowel correspondence
18.	Where is my juffle?	O	Syllabic consonant
19.	Paint the widge red.	O	Vowel correspondence
20.	The men were enlatted on Friday.	O	Vowel correspondence
21.	That raffom costs a dollar.	O	Syllabic consonant
22.	A gadden a day keeps the doctor away.	O	Syllabic consonant
23.	He is bining his brother.	O	Vowel correspondence.
24.	Let's go to a wance.	O	Consonant correspondence
25.	She has a good goice.	O	Consonant correspondence
26.	It is a rundy day.	M	Adjectival y
27.	My boat goes vister than yours.	M	Comparative
28.	This is the gobbest book I ever read.	M	Superlative
29.	They will biden the baby.	O	Vowel correspondence
30.	They are zabbing very slowly.	O	Vowel correspondence

The words were different from those used in Test 1, but exemplified the same patterns used in Tests 1 and 2. Test 3 was presumed to be more difficult than Test 1. It was thought that correct spelling from dictation would be greater proof of knowledge of the patterns being tested in Test 1.

Each of the test words was put into a carrier phrase which was of no particular importance to the orthographic items. However, for the morphological items it was of crucial importance. Only by attending to the carrier phrase in these items could the correct choice be made or spelled.

In Tests 1 and 2 an item was scored correct if the right answer was underlined, circled or somehow indicated. If none, or more than one, of the alternatives was circled or underlined, the item was scored as incorrect. In Test 3, an item was scored correct if that section of the word demonstrating knowledge of the pattern was spelled correctly. For instance, in Item 3, bids, feds or fibs would be considered as the correct spelling of the pattern exemplified in /fIds/, whereas fidz would be considered incorrect.

Experimental Design

The experimental plan was a mixed model, a 4 x 2 x 2 factorial design with repeated measures on the last factor and 20 subjects in each group (Winer, 1962; pp. 155, 337).

A, B, s(AB), C

where A ⟶ Grade levels 2, 3, 4 and 5

B ⟶ Spelling Ability, good and poor

C ⟶ Spelling Patterns, morphological and orthographic

D ⟶ Subjects, nested in A and B with repeated measures on C

Procedure

Subjects were tested as a group in their own classroom. An examiner and an assistant were always present. Each of the tests was administered separately with a minimum lapse of two hours between tests. The three tests were always presented in the order Test 1, Test 2 and Test 3. The children were asked to write their name and grade in the space provided on the first page. The nature of the test was briefly and simply described to the children. For each test there were two practice items. The first of these was demonstrated on the blackboard. For the two multiple-choice tests the children were asked to cross out an item if they changed their mind and wished to make a new choice. For each item the examiner said the word, then a carrier phrase containing the word, and then repeated the word. The examiner repeated an item if requested to do so. The children were encouraged to guess if they were unsure of the answer.

RESULTS

Comparisons among and between groups were made using analysis of variance and analysis of covariance programs (Dixon, 1970) and product-moment correlations. An analysis of variance was performed on each of the three tests: Test 1 - multiple-choice, nonsense words, Test 2 - multiple-choice, real words, and Test 3 - nonsense words written from dictation. The independent variables were Grade (A), Spelling Ability (B), and Spelling Patterns (C).

Test 1 (multiple-choice, nonsense words)

Table 6 shows the percentage of correct responses for Test 1 as a function of Grade, Spelling Ability and Spelling Patterns (morphological and orthographic) for 20 good and 20 poor spellers at each grade level from two to five. Percentage of correct responses increased systematically from grade to grade. Only in one instance (good spellers on orthographic patterns from Grade 3 to Grade 4) was there no appreciable increase. Good spellers were clearly better than poor spellers for each pattern at each grade level. Good spellers tended to find orthographic patterns easier than morphological patterns, while the reverse was true for poor spellers. As a consequence, overall percentages on the two patterns for combined groups were very similar. Poor spellers displayed little, if any, knowledge of spelling patterns until Grade 4. On morphological patterns poor spellers performed at chance level in Grade 2 and not far above in Grade 3, while for orthographic patterns they were just below

TABLE 6

Percentage of correct responses on Test 1 (multiple-choice, nonsense words) as a function of Grade, Spelling Ability and Spelling Patterns, morphological (M) and orthographic (O), where 20 good and 20 poor spellers were tested at each grade.

Grade	Poor Spellers			Good Spellers			Combined Groups		
	M	O	M & O	M	O	M & O	M	O	M & O
2	31	25	28	53	51	52	42	38	40
3	46	36	41	59	69	64	52	53	52
4	52	57	55	66	69	68	59	63	61
5	67	64	65	75	82	79	71	73	72
Mean	49	45	47	63	68	66	56	56	

chance at the Grade 2 level and just above chance at Grade 3. Good spellers were well above chance at Grade 2. The performance of the second grade good spellers is comparable to that of the fourth grade poor spellers.

Table 7 shows the results of the analysis of variance for Test 1. There were highly significant Grade (A) and Spelling Ability (B) effects, but the Spelling Patterns (C) effect was not significant. Although the difference between the good spellers and the poor spellers tended to decrease over grades (Table 6), the AB interaction was not significant. The significant BC interaction (Figure 1) demonstrated that the two groups of spellers performed differently on the two types of patterns, as described above. The significant ABC interaction (Figure 2) occurred because the different trends for morphological and orthographic patterns for good and poor spellers (BC interaction) were not consistent over each grade level. The superiority of morphological patterns over orthographic patterns for poor spellers did not occur in Grade 4, while the superiority of orthographic patterns over morphological patterns for good spellers did not occur in Grade 2.

Test 2 (multiple-choice, real words)

Table 8 shows the percentage of correct responses for Test 2. As was the case for Test 1, percentage of correct responses increased from grade to grade; good spellers were clearly better than poor spellers for each pattern at each grade level, and the difference between the two groups of spellers was less marked in the higher grades than in the lower grades. However, the percentage of correct responses for both groups was higher for orthographic patterns than for morphological patterns.

TABLE 7

Summary of analysis of variance for Test 1 (multiple-choice, nonsense words).

	MS	df	F	Significance Level
Grade (A)	14693.510	3	51.441	.001
Spelling Ability (B)	27615.450	1	96.681	.001
Spelling Patterns (C)	41.688	1	.292	NS
AB	739.023	3	2.587	NS
AC	217.881	3	1.524	NS
BC	1323.970	1	9.259	.005
s(AB)	285.636	152		
ABC	435.208	3	3.044	.05
sC(AB)	142.998	152		

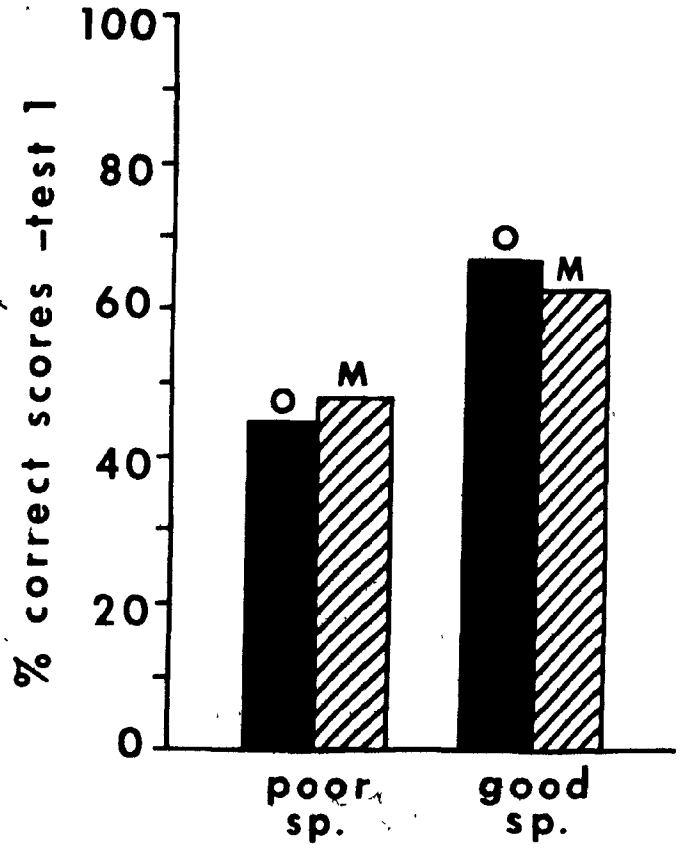


Figure 1: Interaction of Spelling Ability and Spelling Patterns, orthographic (O) and morphological (M) - Test 1.

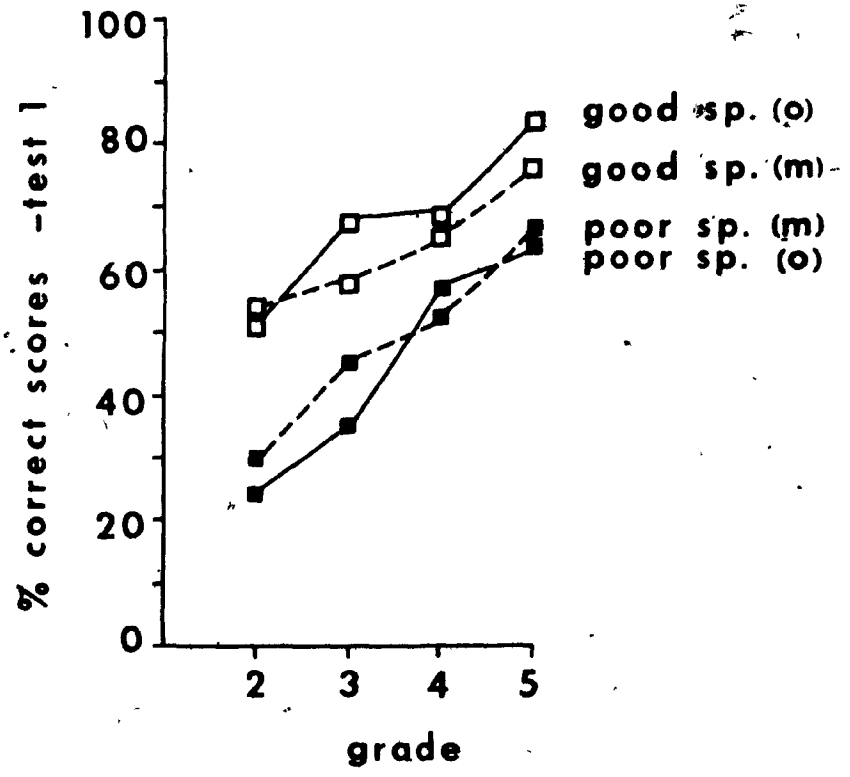


Figure 2: Interaction of Grade, Spelling Ability and Spelling Patterns, orthographic (O) and morphological (M) - Test 1.

TABLE 8

Percentage of correct responses on Test 2 (multiple-choice, real words) as a function of Grade, Spelling Ability and Spelling Patterns, morphological (M) and orthographic (O), where 20 good and 20 poor spellers were tested at each grade.

	Poor Spellers			Good Spellers			Combined Groups		
Grade	M	O	M & O	M	O	M & O	M	O	M & O
2	40	40	40	70	73	72	55	57	56
3	61	67	64	77	88	83	69	78	73
4	72	78	75	85	89	87	78	84	81
5	86	89	87	93	95	94	89	92	91
Mean	64	69	67	81	86	84	73	77	

The Grade 2 poor spellers' performance slightly exceeded chance and indicated some knowledge of spelling patterns in real words. As in Test 1, the Grade 2 good spellers performed as well as the Grade 4 poor spellers.

Table 9 shows the results of the analysis of variance for Test 2. There were significant Grade (A), Spelling Ability (B) and Spelling Patterns (C) effects. The AB interaction was significant (Figure 3). It reflected the smaller difference between the two groups of spellers in the higher grades. None of the remaining interactions (AC, BC, ABC) was significant.

Test 3 (nonsense words written from dictation)

Table 10 shows the percentage of correct responses for Test 3. Scores on the test increased from grade to grade. The largest increase was from Grade 2 to Grade 3. The good spellers were clearly better than the poor spellers for each type of pattern at each grade level. The gap between the two groups was much less in Grades 4 and 5 than in Grades 2 and 3. The good spellers performed slightly better on orthographic patterns than on morphological patterns, while the poor spellers performed slightly better on morphological patterns. As in Test 1, Grade 2 poor spellers knew almost no patterns, but by Grade 3 knew almost a third of them. The Grade 2 good spellers' performance fell just below that of the Grade 4 poor spellers.

Table 11 shows the results of the analysis of variance for Test 3. There were significant Grade (A) and Spelling Ability (B), but not Spelling Patterns (C) effects. The significant AB interaction

TABLE 9

Summary of analysis of variance for Test 2 (multiple-choice, real words).

	MS	df	F	Significance Level
Grade (A)	1735.500	3	96.165	.001
Spelling Ability (B)	23841.240	1	131.950	.001
Spelling Patterns (C)	1697.864	1	22.668	.001
AB	2420.874	3	13.398	.001
AC	191.422	3	2.556	NS
BC	22.313	1	.299	NS
s(AB)	180.684	152		
ABC	34.018	3	.454	NS
sC(AB)	74.900	152		

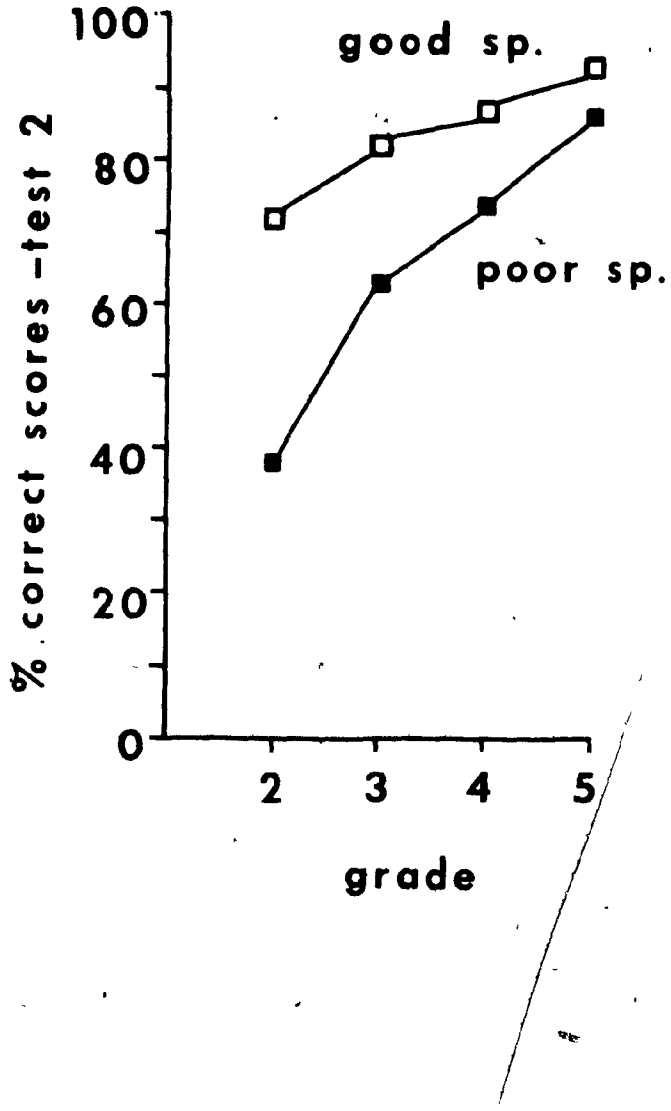


Figure 3: Interaction of Grade and Spelling Ability - Test 2.

TABLE 10

Percentage of correct responses on Test 3 (nonsense words written to dictation) as a function of Grade, Spelling Ability and Spelling Patterns, morphological (M) and orthographic (O), where 20 good and 20 poor spellers were tested at each grade.

	Poor Spellers			Good Spellers			Combined Groups		
Grade	M	O	M & O	M	O	M & O	M	O	M & O
2	8	6	7	41	39	40	25	22	23
3	28	29	29	59	59	59	43	44	44
4	47	50	49	63	71	67	55	60	58
5	70	59	64	78	88	83	74	73	74
Mean	38	36	37	60	64	62	49	50	

TABLE 11

Summary of analysis of variance for Test 3 (nonsense words written to dictation).

	MS	df	F	Significance Level
Grade (A)	36257.870	3	133.281	.001
Spelling Ability (B)	50295.430	1	184.882	.001
Spelling Patterns (C)	45.753	1	.436	NS
AB	1277.169	3	4.695	.005
AC	249.695	3	2.378	NS
BC	755.221	1	7.192	.01
s(AB)	272.040	152		
ABC	549.616	3	5.234	.005
sC(AB)	105.008	152		

(Figure 4) reflected the smaller difference between the two groups of spellers in the higher grades. The significant BC interaction (Figure 5) indicated that the two groups of spellers performed differently on the two spelling patterns as described above. The significant ABC interaction (Figure 6) occurred because the different trends for morphological and orthographic patterns for good and poor spellers (BC interaction described above) were not consistent over each grade level. The superiority of orthographic patterns over morphological patterns for good spellers, noted in the BC interaction, appears only in Grades 4 and 5, while the superiority of morphological patterns over orthographic patterns for poor spellers appears only in Grade 5. The trend for the difference between the two groups of spellers to lessen in the higher grade (AB interaction) was much stronger for morphological patterns than for orthographic patterns.

Summary of Results of Analyses of Variance for Tests 1, 2 and 3

In all three of the analyses of variance there were significant main effects for Grade (A) and Spelling Ability (B). Spelling Patterns (C) was significant only for Test 2 (multiple-choice, real words) where scores on orthographic patterns were higher than those for morphological patterns. There was a significant AB interaction for Tests 2 and 3. The two groups performed less differently in the higher grades. The trend for Test 1 was also in this direction, but it did not reach significance. The AC interaction was not significant in any of the tests, indicating that the relationship between the scores for the two spelling patterns did not change appreciably from grade to grade for the

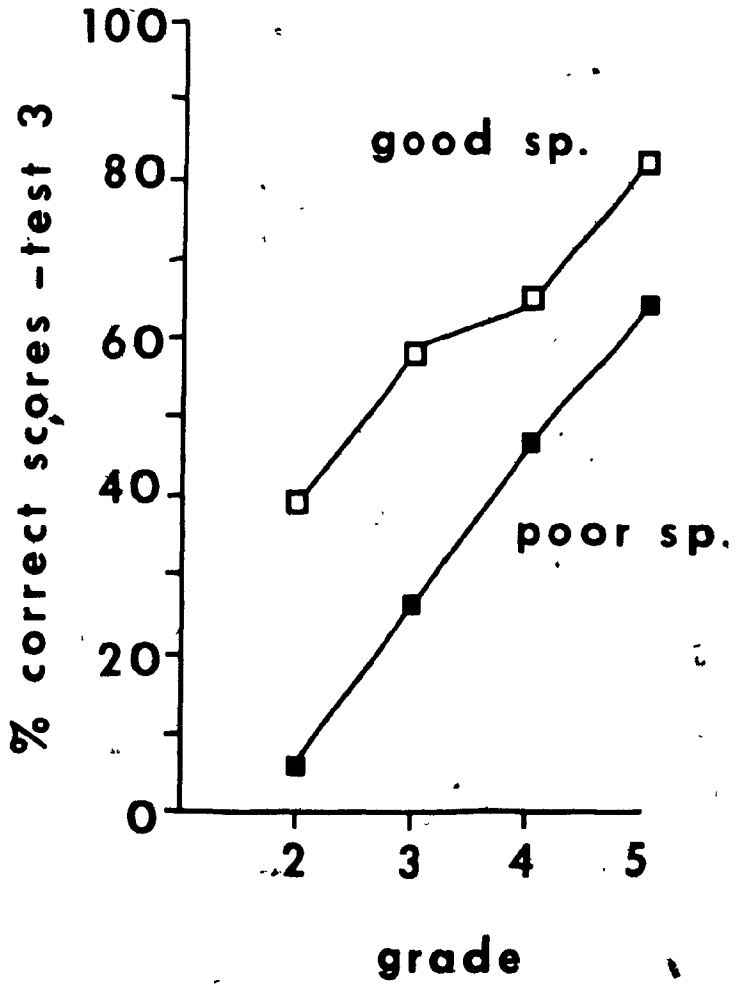


Figure 4: Interaction of Grade and Spelling Ability - Test 3.

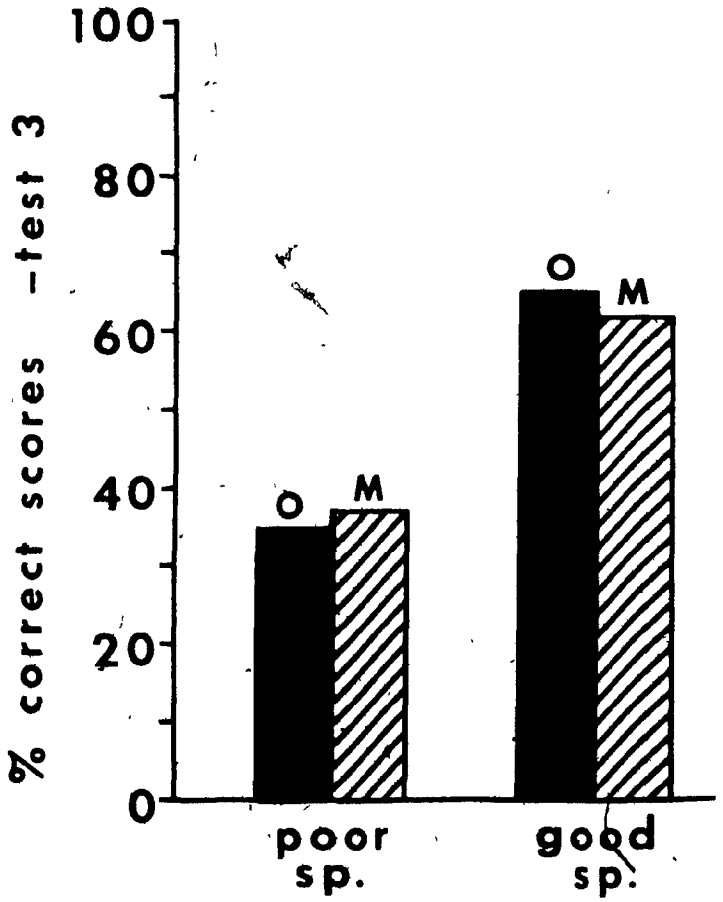


Figure 5: Interaction of Spelling Ability and Spelling Patterns, orthographic (O) and morphological (M) - Test 3.

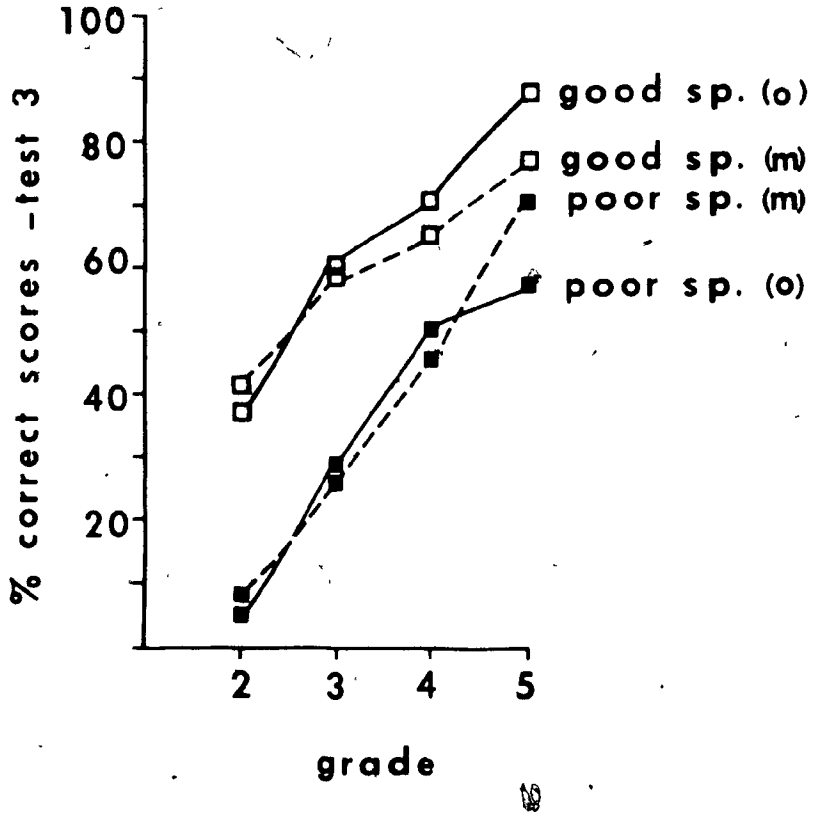


Figure 6: Interaction of Grade, Spelling Ability and Spelling Patterns, orthographic (O) and morphological (M) - Test 3.

two groups taken together. The BC interaction and the ABC interaction were significant for Tests 1 and 3. For both of these tests involving nonsense words, poor spellers tended to find morphological patterns easier than orthographic patterns, while the reverse was true for good spellers However, these trends were not perfectly consistent. In Test 1 the morphological superiority decreased with grade level for the poor spellers, whereas the orthographic superiority increased with grade level for good spellers. In Test 3, the respective morphological and orthographic superiorities only emerged in the higher grades. On the two tests using nonsense words (Tests 1 and 3) poor spellers in Grade 2 displayed little, if any, knowledge of spelling patterns. On Test 2, the Grade 2 poor spellers performed only just above chance level. The Grade 2 good spellers performed as well or nearly as well as the Grade 4 poor spellers on all of the tests.

To rule out the possibility that some of the significant effects were partially attributable to covariance of the experimental variables with intelligence, an analysis of covariance was carried out on each of the three tests, covarying for intelligence test scores. All of the main effects and interactions remained significant, and indeed, the AB interaction became significant ($p < .05$) for Test 1.

To rule out the possibility that differences between orthographic and morphological items occurred merely as a function of the particular samples of items that were chosen, quasi-F ratios were calculated for each test, as suggested by Clark (1973). Another set of analyses of variance, using individual items as a random factor (Balanova 5, 1968) was carried out for each of the three tests. With the new F-ratios (F_2 below) computed, a minimum quasi-F (F') was.

calculated using the formula:

$$F'(i, j) = \frac{F_1 F_2}{F_1 + F_2}$$

where F_1 (the original F-ratio) has n and n_1 degrees of freedom and F_2 (the new F-ratio) has n and n_2 degrees of freedom and i = n. j was calculated from the formula:

$$j = \frac{(F_1 + F_2)^2}{\frac{F_1^2}{n_2} + \frac{F_2^2}{n_1}}$$

(Clark, 1973, p.47). In all cases where there was a non-significant min F', a max F' was calculated using the following formulae:

a) max $F' = (1 + F_3^* / F_1)$ min F' for $F_1 > F_2$

and

b) max $F' = (1 + F_3^* / F_2)$ min F' for $F_2 > F_1$

Clarke, 1973, p. 47).

For all of the tests the min F' was significant ($p < .001$) only for the Grade and Spelling Ability effects. The difference between Spelling Patterns on Test 2 became non-significant, as did all significant interactions. The only significant max F' ($p < .05$) was in Test 3 for the Grade by Spelling Ability interaction. These results are supportive of the original highly significant Grade and Spelling Ability effects; however, they lend no support to the trend noted in pattern difference between groups. Thus, conclusions regarding differences between the spelling patterns must be restricted to the items that were chosen. Further testing on other populations and using other test words would

resolve whether there are differences between the two spelling patterns.

Figure 7 shows the relative difficulty of each test. As expected, scores on Test 2 (multiple-choice, real words) were higher than those on the other two tests. Scores on Test 1 (multiple-choice, nonsense words) were higher than those for Test 3 (nonsense words written from dictation) except at the Grade 5 level. Here there was a reversal, with Test 3 scores higher than Test 1 scores. An examination of Tables 6 and 10 shows that this superiority of Test 3 over Test 1 at the Grade 5 level is consistent for both morphological and orthographic patterns for good spellers, but only for morphological patterns for the poor spellers. Because a different mode of response (written) was used in Test 3, it was not appropriate to compare the three tests in a single analysis of variance. However, an analysis of variance comparing Tests 1 and 2 showed that the percentage correct scores in Test 2 were significantly higher than those in Test 1.

Product-Moment Correlations

To further investigate the relationship of pattern abstraction and the ability to spell real words, product-moment correlations were calculated for the good and poor spellers combined at each grade level between IQ scores, Durrell Spelling Test scores, scores on Tests 1, 2 and 3, and the orthographic and morphological sub-patterns in each test, a total of nine test scores. The complete matrix of intercorrelations is shown in Appendix C.

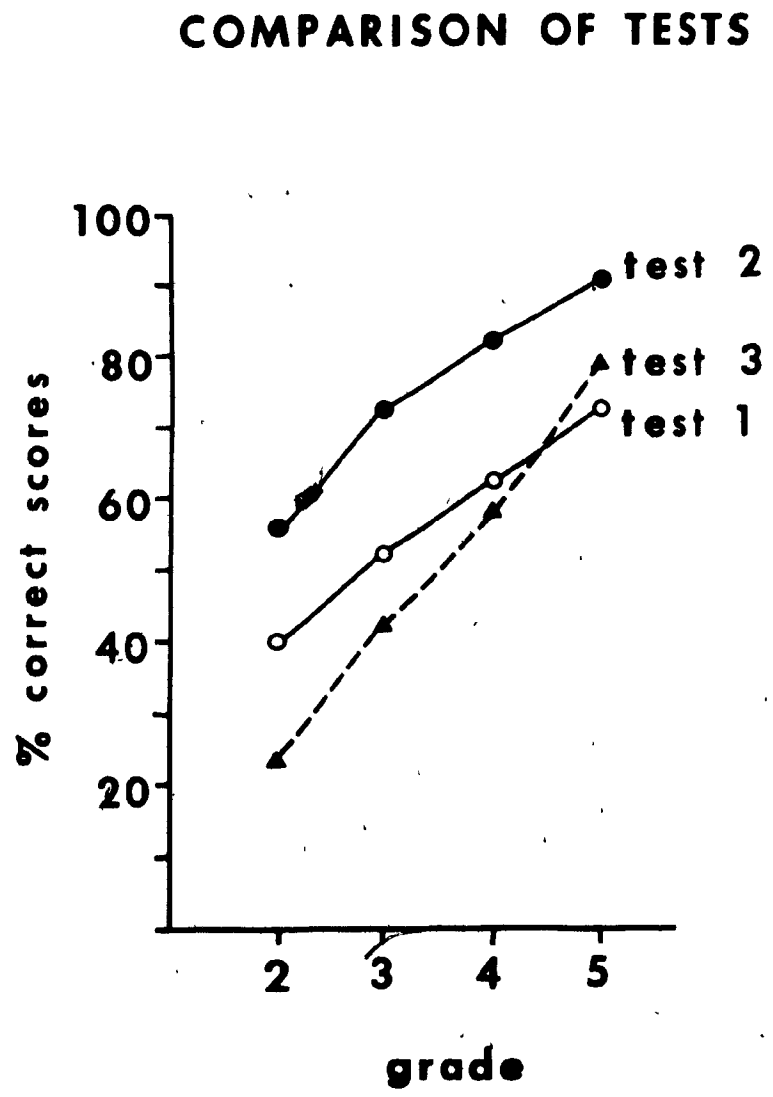


Figure 7: Comparison of Tests 1, 2 and 3 using percentage correct scores.

IQ Test Scores. The product-moment correlations of intelligence test scores with scores on the Durrell Spelling Test and the three experimental tests for each grade are shown in Table 12. Intelligence test scores correlated significantly with very few spelling variables in Grades 2 and 3. At the Grade 2 level there was a significant correlation with the Durrell Spelling Test and with Test 3, while at the Grade 3 level there were no significant correlations. At the Grade 4 level intelligence correlated significantly with the Durrell Spelling Test and each of the experimental tests. At Grade 5 it correlated significantly with the Durrell Test and Tests 2 and 3.

Durrell Spelling Test. Table 13 shows the product-moment correlations of the Durrell Spelling Test with each of the three tests for each grade. All correlations were significant. The correlations were higher for Grades 2 and 3 than for Grades 4 and 5. In all but Grade 3, the Durrell Spelling Test correlated highest with Test 3. One might have expected that the correlation would have been highest with Test 2 where real words were used. However, the high correlation of the Durrell Test with Test 3 may be explained by the fact that both tests employ similar modes of response (i.e. written).

Intercorrelation of Tests 1, 2 and 3. Table 14 shows the intercorrelations among the three tests. The correlations were all relatively high, more so in Grades 2 and 3 than in Grades 4 and 5. The correlation between Tests 1 and 2, and between Tests 1 and 3 remained quite similar for each grade. These results suggest that perhaps the three tests were all measuring the same skills and that pattern abstraction was operating in Test 2 as well.

TABLE 12

Product-moment correlations of IQ with the Durrell Spelling Test and experimental tests for each grade.

Grade	Durrell Spelling Test	Test 1	Test 2	Test 3
2	.32*	.05	.10	.41**
3	.23	.21	.26	.16
4	.57**	.62**	.51**	.52**
5	.63**	.24	.40*	.58**

* $p < .05$ ** $p < .01$

TABLE 13

Product-moment correlations of Durrell Spelling Test with the three experimental tests for each grade.

Grade	Test 1	Test 2	Test 3
2	.74**	.83**	.89**
3	.81**	.81**	.77**
4	.62**	.58**	.70**
5	.54**	.58**	.79**

** $p < .01$

TABLE 14

Intercorrelations of Tests 1, 2 and 3 for each grade.

Grade	Test 1/Test 2	Test 1/Test 3	Test 2/Test 3
2	.75**	.75**	.69**
3	.72**	.72**	.80**
4	.60**	.61**	.53**
5	.62**	.57**	.61**

** $p < .01$

Spelling Patterns. Table 15 shows the product-moment correlations of the Durrell Spelling Test with the spelling patterns in the three tests at each grade. It correlated significantly with all of the test patterns at each grade level. For both of the tests employing nonsense words (Tests 1 and 3), the Durrell Spelling Test correlated higher with the orthographic patterns than with the morphological patterns in all grades.

Morphological and orthographic patterns were almost all significantly correlated for each test at each grade level (Table 16), suggesting considerable interdependence of the skills involved.

Item Analyses

For each of the tests, three types of item analysis were carried out: 1) Chi-square tests were performed to test the significance of the difference between the number of good and poor spellers who passed each item at each grade level. 2) To estimate the grade level at which patterns were mastered, a criterion of 15 children out of a possible 20 passing was chosen as an indication of the grade level at which the item was mastered. This proportion of passes is significantly greater than chance ($p < .003$). 3) The items in each test were rank ordered from easiest to hardest.

Test 1. The results of the chi-square tests performed to test the significance of the difference between the number of good and poor spellers who passed Test 1 at each grade level can be seen in Table 17. Twenty-two items (73.3% - 76.4% of orthographic items and 69.2% of morphological items) discriminated between good and poor

TABLE 15

Product-moment correlations of the Durrell Spelling Test with Spelling Patterns, morphological (M) and orthographic (O), in each grade.

	Test 1		Test 2		Test 3	
Grade	M	O	M	O	M	O
2	.61**	.71**	.78**	.75**	.77**	.90**
3	.50**	.82**	.67**	.77**	.73**	.74**
4	.45**	.54**	.63**	.52**	.55**	.60**
5	.34**	.58**	.38**	.58**	.44**	.78**

** $p < .01$

TABLE 16

Product-moment correlations of orthographic and morphological patterns in the three experimental tests for each grade.

Grade	Test 1	Test 2	Test 3
2	.59**	.72**	.78**
3	.54**	.63**	.82**
4	.28	.72**	.68**
5	.58**	.36*	.34*

* $p < .05$ ** $p < .01$

TABLE 17

Item analyses of Test 1.

	Item		Pattern and Sub-Pattern	Signif. diff. between good & poor spellers: Grade 2	3	4	5	Grade pattern mastered: Good	Poor	Rank Order
9.	nike	O	Vowel correspondence	*	*			2	4	1
1.	fops	M	Pluralization				*	3		2.5
27.	jister	M	Comparative	*		*		4	4	2.5
8.	hope	O	Vowel correspondence	*		*		2		4
2.	otches	M	Pluralization		*			3	5	5.5
22.	ludden	O	Syllabic consonant		*			3	4	5.5
7.	zill	O	Vowel correspondence		*			5	5	7
13.	ralled	M	Past tense					3	4	8.5
21.	hattom	O	Syllabic consonant	*	*			3	4	8.5
24.	rance	O	Consonant correspondence	*	*			3	4	10
14.	ladded	M	Past tense	*	*			2	5	11
17.	votch	O	Vowel correspondence		*	*	*	4		12
30.	fipping	O	Vowel correspondence	*				5	5	13
25.	goice	O	Consonant correspondence	*	*	*		3		14
26.	pendy	M	Adjectival y			*		4	5	15
15.	poshed	M	Past tense	*	*			2	5	16
6.	liss	O	Vowel correspondence				*	5		17
10.	wap's	M	Singular possessive				*	5		18
16.	bouge	O	Consonant correspondence	*	*	*		5		19
3.	ruds	M	Pluralization		*			5	5	20
19.	bidge	O	Vowel correspondence	*	*	*		4		21
12.	quiff	O	Consonant correspondence					5		22
28.	jankest	M	Superlative						5	23
5.	smies	M	Pluralization					5		24.5
20.	engatted	O	Vowel correspondence							24.5
18.	hoffle	O	Consonant correspondence							26
4.	flays	M	Pluralization				*			27
29.	stiden	O	Vowel correspondence				*			28
23.	kabing	O	Vowel correspondence							29
11.	waps'	M	Plural possessive							30

spellers at one or more grade levels: of these, 11 (36%) were at Grade 2, 13 (43.4%) at Grade 3, seven (23.3%) at Grade 4 and six (20%) at Grade 5. In all, a higher percentage of orthographic items than morphological items discriminated between the two spelling groups. However, this was true only in Grades 2, 3, and 4 (see Figure 8).

Table 17 also shows the grade level at which items were mastered by good and poor spellers. Good spellers began earlier and in general tended to be well in advance of the poor spellers. In only one instance (Item 28) did poor spellers master a sub-pattern before the good spellers. Six items were not mastered by either group. The good spellers mastered 23 items (76.7%-76.5% of orthographic patterns and 76.9% of morphological patterns): of these, four were mastered at Grade 2, two orthographic and two morphological; seven more at Grade 3, four orthographic and three morphological; four more at Grade 4, two orthographic and two morphological, and eight more at Grade 5, five orthographic and three morphological. The poor spellers did not master any item before Grade 4 and by Grade 5 they had mastered only 14 items (46.7%-35.3% of the orthographic items and 61.5% of the morphological patterns): of these six were mastered at Grade 4, four orthographic and two morpholgoical, and eight more at Grade 5, two orthographic and six morphological (see Figure 9). The good spellers mastered an approximately equal percentage of the two types of patterns. However, poor spellers mastered a greater percentage of morphological items. As a consequence the two groups differed more on their mastery of orthographic patterns than morphological patterns.

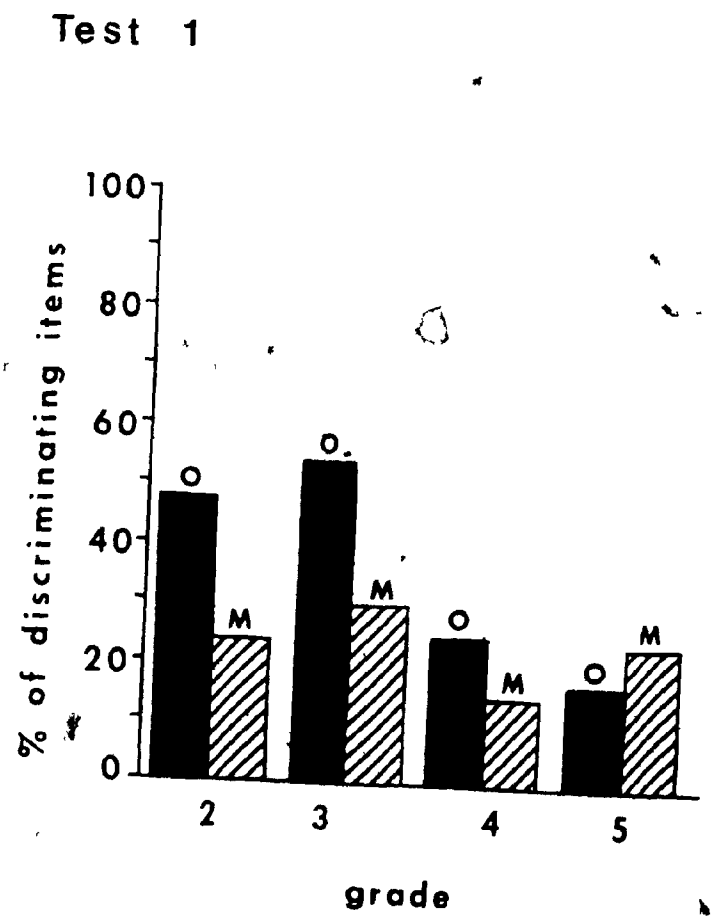


Figure 8: Percentage of orthographic (O) and morphological (M) items that discriminated between good and poor spellers at each grade level - Test 1.

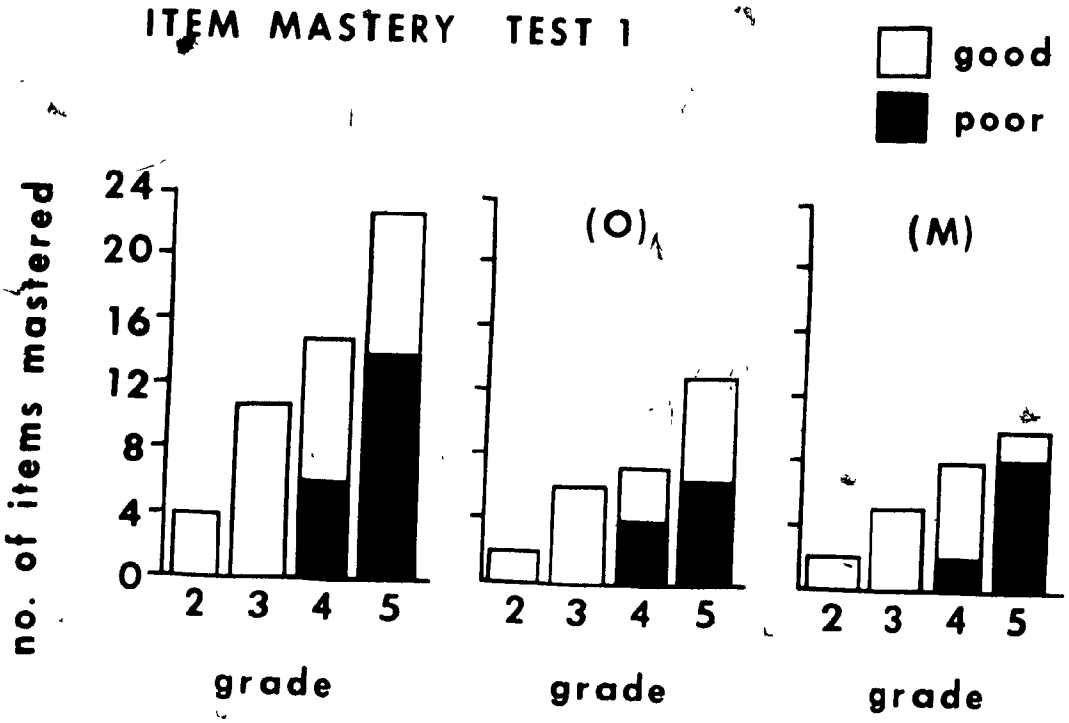


Figure 9: Number of orthographic (O) and morphological (M) items mastered by good and poor spellers by each grade level - Test 1.

The items in Test 1 were rank ordered from least to most difficult and can be seen in Table 17. There was no systematic relationship between rank and morphological and orthographic sub-patterns.

Test 2. Table 18 shows the results of the chi-square tests performed to test the significance of the difference between the number of good and poor spellers who passed each item in Test 2 at each grade level. Twenty-five items (83.3%-88.2% of the orthographic items and 76.9% of the morphological items) discriminated between good and poor spellers at one or more grade levels: of these 20 (66.7%) were at Grade 2, 13 (43.3%) at Grade 3, two (6.7%) at Grade 4 and three (10%) at Grade 5. The percentage of morphological and orthographic items that discriminated between groups at each grade level is shown in Figure 10. As in Test 1, a greater percentage of orthographic patterns than morphological patterns discriminated between the two groups of spellers. When looked at grade by grade, one sees that this is only true in Grade 2.

The grade level at which items were mastered by good and poor spellers is also shown in Table 18. As in Test 1, the good spellers began earlier and in general tended to be in advance of the poor spellers; however, pattern mastery began earlier in Test 2 than in Test 1. No item was mastered by the poor spellers before it was mastered by the good spellers. Two items were not mastered by either group. There was a fairly striking difference in item mastery in Grade 2. Here the good spellers had mastered 19 items (63.3%) while the poor spellers had mastered only two items (6.7%). By Grade 5 the good spellers had mastered 28 items (93.3%-94.1% of the orthographic items and 92.3% of the morphological items): of these, 19 by Grade 2, 11 orthographic and eight

TABLE 18

Item analyses of Test 2

	Item		Pattern and Sub-Pattern	Signif. diff. between good & poor spellers: Grade 2	3	4	5	Grade pattern mastered: Good	Poor	Rank Order
7.	will	O	Vowel correspondence					2	2	1
8.	name	O	Vowel correspondence	*				2	3	2
1.	tops	M	Pluralization					2	2	3.5
9.	like	O	Vowel correspondence	*				2	3	3.5
13.	called	M	Past tense	*				2	3	5
3.	beds	M	Pluralization	*	*			2	4	6.5
24.	once	O	Consonant correspondence	*				2	3	6.5
18.	little	O	Syllabic consonant	*				2	3	8.5
16.	age	O	Consonant correspondence	*				2	3	8.5
6.	less	O	Vowel correspondence	*				2	3	10
22.	sudden	O	Syllabic consonant	*	*			2	4	11.5
27.	faster	M	Comparative	*				2	3	11.5
26.	sandy	M	Adjectival y	*				2	3	13
14.	needed	M	Past tense	*				2	3	14.5
17.	match	O	Vowel correspondence	*				2	3	14.5
21.	bottom	O	Syllabic consonant	*	*			2	4	16
15.	washed	M	Past tense	*	*			2	4	17.5
25.	voice	O	Consonant correspondence	*	*			2	4	17.5
19.	edge	O	Vowel correspondence		*			3	4	19
4.	plays	M	Pluralization		*	*	*	3	5	20.5
12.	quite	O	Consonant correspondence	*	*			3	4	20.5
2.	matches	M	Pluralization	*	*			2	4	22
28.	shortest	M	Superlative		*			3	5	23
30.	stopping	O	Vowel correspondence	*	*			3	5	24
23.	smiling	O	Vowel correspondence			*		5		25
20.	regretted	O	Vowel correspondence							26
10.	cat's	M	Singular possessive					5	5	27
5.	flies	M	Pluralization		*		*	5		28
29.	widen	O	Vowel correspondence	*	*		*	5		29
11.	cats'	M	Plural possessive							30

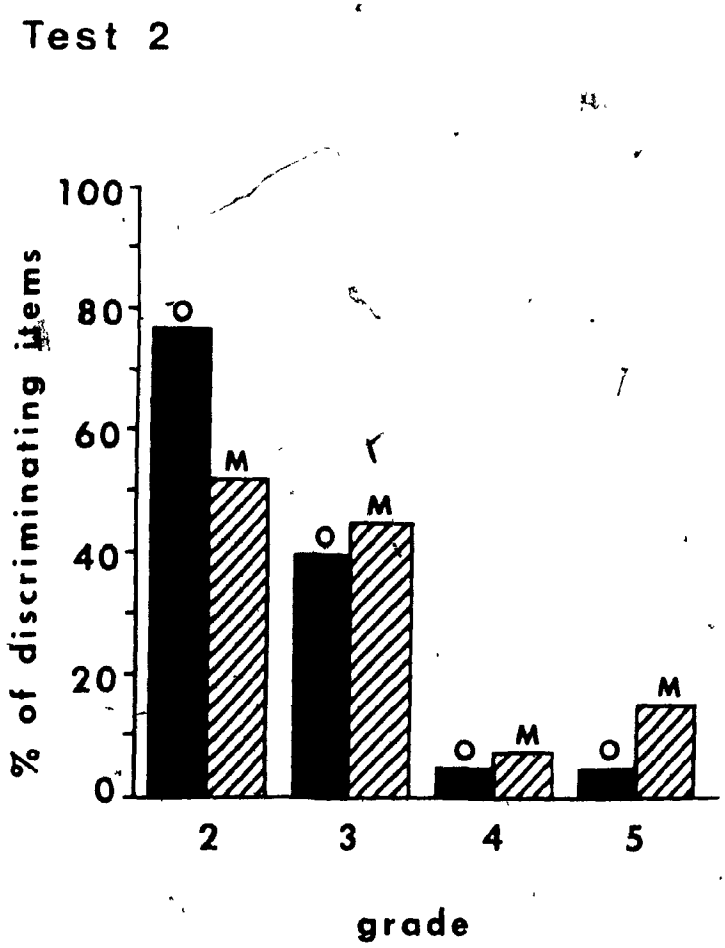


Figure 10: Percentage of orthographic (O) and morphological (M) items that discriminated between good and poor spellers at each grade level - Test 2.

morphological, five more by Grade 3, three orthographic and two morphological, no more by Grade 4 and four more by Grade 5, two orthographic and two morphological. The poor spellers mastered 25 items in all (83.3% - 82.4% of the orthographic items and 84.6% of the morphological items): of these, two at Grade 2, one orthographic and one morphological; 11 more by Grade 3, seven orthographic and four morphological, eight more by Grade 4, five orthographic and three morphological, and four more by Grade 5, one orthographic and three morphological (see Figure 11). The good spellers mastered a slightly higher percentage of orthographic patterns than morphological patterns, while the reverse was true for poor spellers. As in Test 1, the two groups differed more on their mastery of orthographic patterns than morphological patterns.

The items in Test 2 were rank ordered from least to most difficult and can be seen in Table 18. Once again there was no consistent relationship between rank and morphological and orthographic subpatterns.

Test 3. The results of the chi-square tests performed to test the significance of the difference between the number of good and poor spellers who passed each item in Test 3 at each grade level are shown in Table 19. Twenty-eight items (93.1% - 100% of the orthographic items and 86.9% of the morphological items) discriminated between good and poor spellers at one or more grade levels: of these 21 (70%) at Grade 2, 21 (70%) at Grade 3, 11 (36.7%) at Grade 4, and nine (30%) at Grade 5. The percentage of morphological and orthographic items that discriminated between groups at each grade level is shown in Figure 12. As in Tests 1 and 2, a greater percentage of orthographic items than

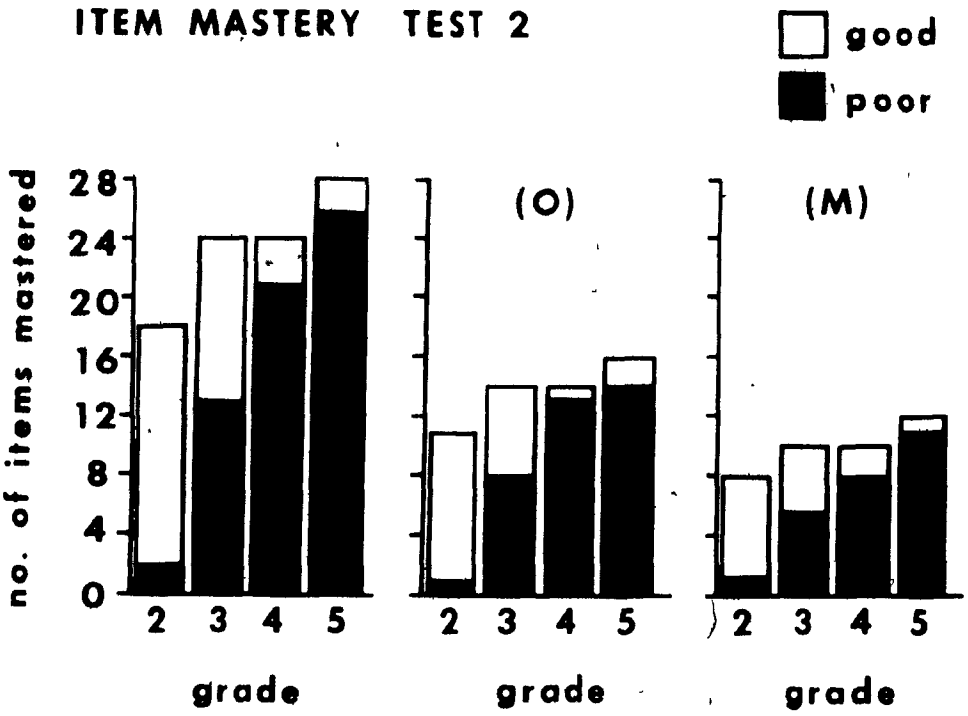


Figure 11: Number of orthographic (O) and morphological (M) items mastered by good and poor spellers by each grade level - Test 2.

TABLE 19

Item analyses of Test 3.

	Item		Pattern and Sub-Pattern	Signif. diff. between good & poor spellers: Grade 2	3	4	5	Grade pattern mastered: Good	Poor	Rank Order
1.	hups	M	Pluralization	*	*			2	4	1
22.	gadden	O	Syllabic consonant	*	*			2	4	2
27.	vister	M	Comparative	*	*			2	4	3
8.	gabe	O	Vowel correspondence	*				2	3	4.5
21.	raffom	O	Syllabic consonant	*				3	4	4.5
3.	fids	M	Pluralization	*	*			2	4	6
9.	vike	O	Vowel correspondence	*	*	*	*	3	5	7
7.	vill	O	Vowel correspondence	*				2		8
2.	ratches	M	Pluralization	*	*	*		3	5	9
16.	nage	O	Consonant correspondence	*	*			3	5	10
14.	joded	M	Past tense	*	*	*		4	5	11
29.	biden	O	Vowel correspondence		*	*		3	5	12
23.	bining	O	Vowel correspondence	*						13
26.	rundy	M	Adjectival y	*	*			5		14
28.	gobest	M	Superlative	*	*			4	5	15
24.	wance	O	Consonant correspondence	*	*	*	*	4		17
15.	mished	M	Past tense	*	*	*		4	5	17
13.	lebbed	M	Past tense	*	*	*		4		17
12.	quab	O	Consonant correspondence	*	*			5		19
6.	tess	O	Vowel correspondence	*	*	*	*	5		20
25.	loice	O	Consonant correspondence	*	*		*	4		21
17.	hotch	O	Vowel correspondence	*	*		*	5		22
18.	juffle	O	Syllabic consonant			*	*	5		23
10.	rad's	M	Singular possessive		*			5		24
30.	zabbing	O	Vowel correspondence		*	*	*	5		25
4.	drays	M	Pluralization		*					26
19.	widge	O	Vowel correspondence			*	*	5		27
11.	rads'	M	Plural possessive							28
20.	enladded	O	Vowel correspondence				*	5		29
5.	bries	M	Pluralization							30

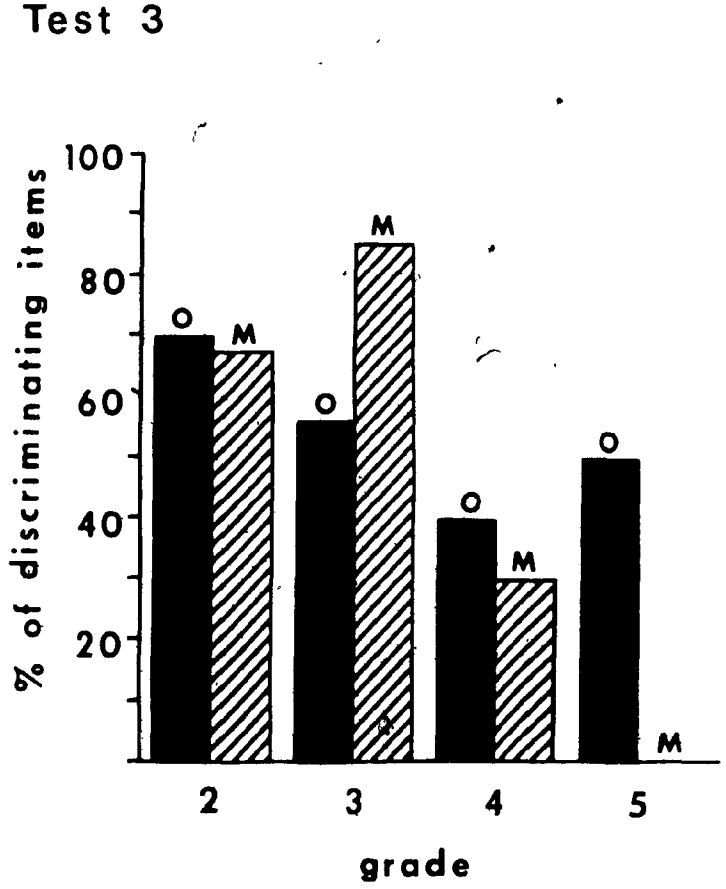


Figure 12: Percentage of orthographic (O) and morphological (M) items that discriminated between good and poor spellers at each grade level - Test 3.

morphological items discriminated between the two spelling groups. However, this was true only in Grades 2, 4 and 5.

Table 19 also shows the grade level at which items were mastered by good and poor spellers. As in Tests 1 and 2, good spellers began earlier and tended to be in advance of the poor spellers in pattern mastery. Four items were not mastered by either group. By Grade 5 the good spellers had mastered 26 items in all (86.7% - 94.1% of the orthographic items and 76.8% of the morphological items): of these, six by Grade 2, three orthographic and three morphological; five more by Grade 3, four orthographic and one morphological; six more by Grade 4, two orthographic and four morphological, and nine more by Grade 5, seven orthographic and two morphological. The poor spellers mastered 13 items in all (43.3% - 35.3% of orthographic items and 53.8% of the morphological items): of these, one by Grade 3, one orthographic; five more by Grade 4, two orthographic and three morphological, and seven more by Grade 5, three orthographic and four morphological (see Figure 13). As in Test 2, the good spellers mastered a greater percentage of orthographic patterns than morphological patterns while the reverse was true for the poor spellers. As in Tests 1 and 2, the groups differed more on their mastery of orthographic patterns than morphological patterns.

The items in Test 3 were rank ordered from least to most difficult and can be seen in Table 19. Again there was no consistent relationship between rank order and morphological and orthographic sub-patterns.

Summary of Item Analyses of Tests 1, 2 and 3. In all of the tests a higher percentage of orthographic items than morphological items

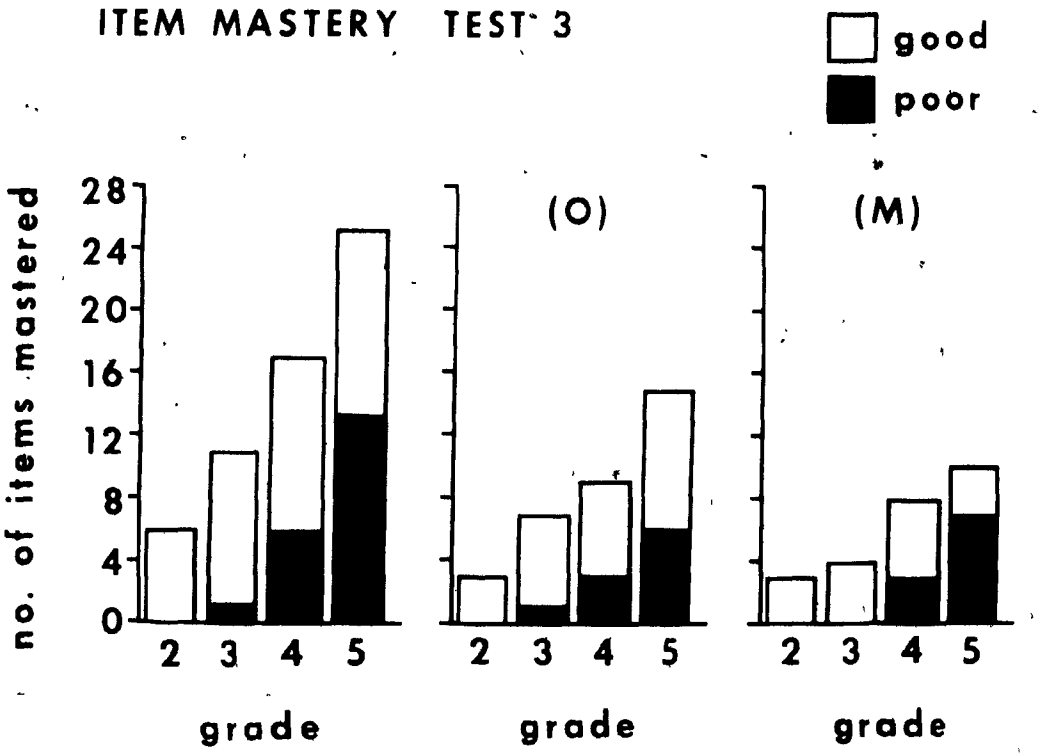


Figure 13: Number of orthographic (O) and morphological (M) items mastered by good and poor spellers by each grade level - Test 3.

discriminated between the two groups of spellers. This is in keeping with the general finding that orthographic patterns were more difficult for the poor spellers and would therefore be more likely to discriminate between groups.

As might have been expected from the significant Spelling Ability effect on the analyses of variance for all three tests, good spellers began earlier and in general tended to be in advance of the poor spellers in pattern mastery on all of the tests. On only one item (28) in Test 1 did poor spellers achieve mastery before the good spellers. On all of the tests, poor spellers mastered a greater percentage of morphological items than orthographic items. This trend was not as strong in Test 2 as in Tests 1 and 3. In Tests 2 and 3 good spellers mastered a higher percentage of orthographic items than morphological items, while in Test 1 the percentage of mastery was about the same for both types of patterns. On all three tests the groups differed more on their mastery of orthographic patterns than morphological patterns.

There was no systematic relationship between rank and morphological and orthographic sub-patterns for any of the tests. Three items were consistently difficult on all of the tests: Item 11 testing the plural possessive, Item 20 testing vowel correspondence in a polysyllabic word and Item 5 testing plurality where an orthographic alternation is involved (i/y). Table 20 shows the ranked difficulty for all three tests. The rank difference correlation was .67 ($p < .01$) between Tests 1 and 2, .67 ($p < .01$) between Tests 1 and 3, and .60 ($p < .01$) between Tests 2 and 3. There was, therefore, a high degree of consistency in the relative difficulty of particular sub-patterns from one test to another.

TABLE 20

Rank order difficulty for Tests 1, 2 and 3.

Item	Test 1	Test 2	Test 3
1.	2.5	3.5	1
2.	5.5	22	9
3.	20	6.5	6
4.	27	20.5	26
5.	24.5	28	30
6.	17	10	20
7.	7	1	8
8.	4	2	4.5
9.	1	3.5	7
10.	18	27	24
11.	30	30	28
12.	22	20.5	19
13.	8.5	5	17
14.	11	14.5	11
15.	16	17.5	17
16.	19	8.5	10
17.	12	14.5	22
18.	26	8.5	23
19.	21	19	27
20.	24.5	26	29
21.	8.5	16	4.5
22.	5.5	11.5	2
23.	29	25	13
24.	10	6.5	17
25.	14	17.5	21
26.	15	13	14
27.	2.5	11.5	3
28.	23	23	15
29.	28	29	12
30.	13	24	25

DISCUSSION

The aim of the present study was to learn about the nature of spelling ability and about children's strategies in learning to spell. Modern linguistic investigations of the relationship between spoken and written English have shown that it is a complex one and cannot simply by explained in terms of sounds being represented by letters or graphemes corresponding to phonemes. The thorough linguistic analysis carried out by Venezky (1967) has indicated that, though complex, there is a considerable degree of regularity and order in the relationship.

Research and theorizing by linguists, psychologists and educators have focused on the reading, rather than the spelling, process. Venezky, Gibson and others have concluded that pattern abstraction is an integral part of learning to read. It seems logical to assume that pattern abstraction might also be operating in the acquisition of spelling, in which case, children identified as good spellers should show greater mastery of spelling patterns than poor spellers. A thorough review of the literature revealed no previous developmental study of pattern abstraction in the spelling process. Other studies on spelling, such as the one done by Hanna et al. (1966), have investigated the more superficial phoneme-grapheme correspondences. There are no studies based on a model postulating an intermediate level between the phonemic and graphemic level as suggested by Venezky, and investigating different types of patterning in the orthography.

The acquisition of two types of patterns was investigated in the present study; orthographic patterns which are related to the written system without regard to sound, and morphological patterns, which relate to the way certain morphological considerations are encoded. Gibson (1971) has theorized that different features (e.g. phonological, graphic, orthographic and syntactic) are processed independently and sequentially in the acquisition of reading. It was therefore expected that the morphological spelling patterns might be learned or abstracted differently from the orthographic patterns.

Three tests were designed to study the abstraction of certain spelling patterns: Test 1, a multiple-choice test of nonsense words using 30 patterns (17 orthographic and 13 morphological); Test 2, a multiple-choice test of real words exemplifying the same patterns used in Test 1; and Test 3, a dictation test of nonsense words (different from those used in Test 1), using the same patterns tested in Tests 1 and 2. Twenty good and 20 poor spellers were tested at each grade from two to five. Knowledge of patterns was assumed from the ability of children to spell nonsense words exemplifying the patterns.

The data confirmed the expectation of differences in the responses of good and poor spellers on the three tests. Good spellers performed better than poor spellers for each pattern at each grade level on all of the tests. Both groups of spellers showed clear developmental trends in their ability to abstract morphological and orthographic patterns on all three tests. Results of Tests 1 and 3 suggest that the poor spellers did not begin to acquire patterns until Grade 4, and in general were about two years behind the good spellers

in pattern acquisition.

These findings demonstrate that pattern abstraction occurs as part of the acquisition of spelling. This is further supported by the high correlations of the Durrell Spelling Test with the three tests. These correlations were higher in the lower grades than in the upper grades, suggesting that other factors may come into play in the later stages of spelling acquisition. Other correlations indicated that the ability to abstract patterns is more related to spelling ability than to intelligence test scores.

On the two tests employing nonsense words (Tests 1 and 3) good spellers had relatively better scores on orthographic patterns than on morphological patterns, while the reverse was true for poor spellers (Figures 1 and 5). This trend was not perfectly consistent over grades. In Test 1 the orthographic superiority for good spellers appeared after Grade 2, while the morphological superiority for poor spellers decreased with grade level (Figure 2). In Test 3 the respective morphological and orthographic superiorities emerged in the higher grades. These results suggest that a greater facility for orthographic pattern abstraction occurs in the more advanced stages of spelling acquisition. In Test 1, as skill improved for the poor spellers, the relative superiority of morphological patterns over orthographic patterns decreased. In Test 3, perhaps because it was relatively harder than Test 1, the same trends did not emerge. In all of the tests a higher percentage of orthographic items than morphological items discriminated between the two groups of spellers, indicating again that orthographic patterns were more difficult for

the poor spellers. The higher correlation of the Durrell Spelling Test with orthographic patterns than with morphological patterns also indicates that orthographic patterns are more highly related to spelling skill.

On Test 2 both groups of spellers scored higher on orthographic patterns than on morphological patterns in all grades except Grade 2 where poor spellers did equally well on both patterns. This suggests that orthographic patterns are learned more easily in word context, but are not identified as readily out of word context.

These results suggest that the two patterns are acquired at different times. An additional hypothesis is that the two patterns are acquired by independent skills. Further testing in higher grades would indicate if the poor spellers do indeed catch up or whether they are deficient in a separate skill involved in the abstraction of orthographic patterns. The positive, but not consistently high, correlation between morphological and orthographic patterns on the three tests (Table 16) would suggest that they do not represent independent skills, but that perhaps there is a general ability to abstract patterns.

However, all conclusions regarding differences and similarities between spelling patterns must be restricted to the particular instances of the patterns utilized in the tests, because these trends were no longer significant when the individual sub-patterns were analyzed as random variables (Clark, 1973). Further conclusions regarding differences between orthographic and morphological patterns must await more complete sampling of the patterns.

Because of the use of real, very familiar words in Test 2, there might be some question as to whether it was indeed measuring pattern abstraction rather than visual memory. However, the similar trends for Spelling Ability and Grade on all three tests, plus the relatively high intercorrelations between the tests, would suggest that the subjects used pattern abstraction rather than rote memory alone in Test 2.

As expected, scores were generally higher on the multiple-choice test using real words (Test 2) than on the two tests using nonsense words. Scores on the multiple-choice test of nonsense words (Test 1) were higher than those on the dictation test of nonsense words (Test 3) in all grades but Grade 5 (Figure 7). Here the good spellers performed better on the written test than on the multiple-choice test, while the poor spellers were relatively more successful on Test 3 than on Test 1 only for the morphological patterns. These findings suggest that for the older and more competent spellers, the ploys in the multiple-choice acted as distractors, or possibly productive skills are better organized. This same trend was noted in a pilot study with 45 college students, where 75.6% of the subjects scored higher on the written test of nonsense words than on the multiple-choice test. This is contrary to the general finding that multiple-choice tests are easier than dictation tests.

One might argue that Test 1 is not unequivocally a spelling test (i.e. sound → spelling). Because it is a multiple-choice test with the spelling clearly evident, it might be construed as a reading test (spelling → sound). However, the task is essentially different

for the reader than for the speller. For the 13 morphological items, at least two of the three choices are read in exactly the same way and only the hearing of the word in the context of the carrier phrase would indicate the correct choice. For example, in Item 1 of Test 1, the carrier phrase is "I have four /fɔps/." and the choices are fopse, fops and fopes. The first two choices read identically. Only by noting the plurality in the carrier phrase and knowing how to indicate plurality in spelling would one be able to make the correct choice, fops.

For the orthographic items where graphemes act as markers to establish the sound correspondence of other graphemes, the patterns tested, though different, are perhaps more related to the reading patterns. For instance, in Item 30 of Test 1, /fIpəŋ/, the choices are fiping, fipping and fipeing. The reader has no problem with the consonant correspondence because all three (p, pp and pe) have the same sound. However, the consonant spelling determines the vowel correspondence; if single, then the vowel is free or long, in this instance /ī/, if double, then the vowel is short or checked, in this instance /ĭ/. The third choice, pe, would initially have to be discarded since the e marker is not necessary in this position. The speller is given the vowel correspondence and must choose the correct consonant spelling (p or pp). If the preceding vowel is checked or short, which it is in this instance, then pp is the appropriate spelling. However, if the preceding vowel were free or long, then p would have been the appropriate spelling.

Test 3 is unequivocally a spelling test where sound is encoded to the written symbol. The similarity in trends for both Tests 1 and 3 and the high correlation between them would indicate that the main effects and interactions observed for Test 1 are not an artifact of multiple choice, nor an artifact of the particular set of nonsense words chosen.

The results of this experiment clearly demonstrate that spelling acquisition involves more than rote memorization of letters in each word. If spelling knowledge were no more than the storing up of memorized words, then children would be unable to spell new forms, exemplifying the same patterns. If a child spells the plural of bed as beds, he may simply have memorized that particular plural spelling. If, however, he can spell the plural form of rud as ruds, there is evidence that he has rules of extension that enable him to deal with new instances. Young, good spellers in Grade 2, before the beginning of formal spelling instruction, had already begun to abstract morphological and orthographic patterns. The good spellers showed orderly developmental trends for both types of patterns on all of the tests. Poor spellers lagged behind the good spellers in the acquisition of patterns by about two years, but also showed an orderly developmental trend. The two groups of spellers differed most in their ability to handle orthographic patterns. In general, good spellers were better on orthographic patterns than on morphological patterns while the reverse was true for poor spellers for Tests 1 and 3. For the items used in this study, orthographic patterns appear to

be acquired at a later stage of spelling skill than morphological patterns.

The consistency and orderliness of the acquisition of the morphological and orthographic patterns tested as a function of grade and spelling ability give credence to the Venezky model from which they were derived, as well as to the Gibson theory of feature abstraction and processing, which contends that the ability to detect and abstract structure improves with age and schooling.

Venezky suggests the existence of two types of correspondences, one type operating between the graphemic level and the morphophonemic level, and a second type operating between the morphophonemic level and the phonemic level. The orthographic patterns would fit into the first type of correspondence, while the morphological patterns would be more akin to the second set. Venezky suggests that many of the second set of correspondences are already learned by the time the child enters school and that the correspondences operating between the graphemic level and the morphophonemic level are learned later. The finding that orthographic patterns tend to be acquired at a later stage of spelling acquisition is in support of Venezky's model, as well as Gibson's contention that the different word features are processed sequentially. The results also seem to be generally in keeping with the four studies investigating spellers' ability to differentiate between approximations to English and which concluded that spelling ability is related to the ability to detect structure or make use of redundancy in the written system (Bruner, 1957; Klein

and Schneider, 1960; Wallach, 1963; McLeod, 1967).

Interpretation of the present study is limited by the fact that there is only one instance of each particular sub-pattern. The item analyses results, although suggestive, did not provide clear guide-lines with regard to children's differential ability to handle sub-patterns. They gave some indication as to when various types of patterns were acquired, but there were no consistent trends for morphological and orthographic patterns. Perhaps a more thorough study with reduction of the number of sub-patterns and more instances per pattern would allow for greater confidence when speaking about pattern mastery or difficulty.

It would be interesting to begin the testing in Grade 1, since it was obvious that by the beginning of Grade 2, the good spellers had already mastered some of the patterns. As mentioned earlier, extending the testing to higher grades (Grades 6 and 7) would provide information as to whether the poor spellers do catch up, or continue to improve but never catch up.

It should be noted that the poor spellers in this study were in no way a very deviant population. They were of average intelligence, had not reapeated any grades and were not singled out by their teachers as having particular difficulty with spelling. In fact, it was felt that the standardized spelling test used to delineate groups was a poor choice since it did not have a wide enough range to allow for very different groups. The poor spellers were the lower third of the total distribution while the good

spellers were the upper third. Perhaps testing children with spelling problems would add further support to the conclusions of the present study, as well as possibly clarify their difficulty. Using a modified test with fewer sub-patterns and several instances of each, as suggested earlier, with normal children and those with spelling problems would determine whether the latter have particular difficulty with some patterns or whether the difficulty is with the type of pattern, i.e. orthographic or morphological.

Poor spellers and younger spellers seemed relatively less able to master the more subtle orthographic patterns - subtle in the sense that they are not marked or highlighted either auditorily or meaningfully. The results suggested that a certain amount of competence and exposure is required before these patterns are acquired. It may be possible to hasten or simplify the problem of orthographic pattern acquisition for the poor spellers simply by structuring the manner of presenting words. Words with distinctive patterns could be congregated so that the underlying regularity could be inferred by the speller himself. For example, the use of minimal pairs such as mating-matting, super-supper, diner-dinner, might highlight the marking function of the double consonant. To further facilitate the process of spelling pattern acquisition or mastery, the existing regularity could be called to the child's attention.

Spelling can thus be considered as belonging to the larger linguistic community of rule-governed behavior, along with reading and language, where skill is acquired through the abstraction

of general principles or patterns. The writings of Chomsky and other linguists and even psychologists (c.f. Gibson, 1971) suggest that the ability to abstract regularity in language in both the oral and written form is innate. All that is required is exposure to the language or to the orthography to discover the particular rules that apply. The behaviorist view of language, which trades heavily on imitation and social reinforcement, does not adequately explain the rapidity and complexity of learning that takes place in the first two or three years of life or the child's ability to utter sentences that he has not previously heard. The present results further indicate that a behaviorist or rote-learning explanation also does not adequately explain how a child learns to spell.

This is the first study investigating the acquisition of spelling patterns. It showed that spelling ability is associated with an orderly acquisition of morphological and orthographic patterns, supporting the notion that an important aspect of spelling behavior is rule-governed. A more complete investigation of the acquisition of spelling patterns awaits a thorough linguistic description and analysis of English orthography in relation to the spelling process. This will provide the exhaustive tabulation of patterns needed for the design of more rigorous investigations of differences among sub-types of patterns. Further research is also needed to develop a general theory of literacy which puts both the process of learning to read and the process of learning to spell in proper perspective.

The following questions were asked:

1. Do children in fact abstract and use patterns in the

spelling process?

2. Is there a developmental change in their ability to do so?

3. Is the ability to abstract patterns a factor in spelling ability?

The results permit a clear, affirmative answer to each of the three.

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APPENDIX A

TEST 1 AND TEST 2

TEST 1

NAME: _____

AGE: _____

GRADE: _____

glak	glack	glac
jostng	jostin	josting

1.	fopse	fops	fopes
2.	otchs	otchez	otches
3.	ruds	rudz	rudes
4.	flaze	flayes	flays
5.	smies	smys	smize
6.	liss	lis	lise
7.	zil	zill	zile
8.	hap	hayp	hape
9.	nike	nik	nyk
10.	waps'	waps	wap's

11.	waps'	waps	wap's
12.	quiff	qwiff	kwiff
13.	rallde	ralled	ralld
14.	laddid	ladded	laddud
15.	poshd	posht	poshed
16.	bouge	bouj	boug
17.	voche	votch	voch
18.	hoffl	hoffel	hoffle
19.	bige	bij	bidge
20.	engated	engatted	engaded

21.	hatm	hattm	hattom
22.	luddn	ludden	ludn
23.	kabbing	kabeing	kabing
24.	rance	ranc	rans
25.	goys	goic	goice
26.	pendey	pendy	pende
27.	jister	jistir	jistr
28.	jankist	jankust	jankest
29.	stiden	styden	stidden
30.	fiping	fipping	fipeing

TEST 2

NAME: _____

AGE: _____

GRADE: _____

blak	black	blac
lasting	lastin	lastng

1.	topse	tops	topes
2.	matchs	matchez	matches
3.	beds	bedz	bedes
4.	plaze	playes	plays
5.	flies	flys	flize
6.	less	les	lese
7.	wil	will	wile
8.	nam	naym	name
9.	like	lik	lyk
10.	cats'	cats	cat's

11.	cats'	cats	cat's
12.	quite	qwite	kwite
13.	callde	called	calld
14.	needid	needed	needud
15.	washd	washt	washed
16.	age	aij	aig
17.	mache	match	mach
18.	littl	littel	little
19.	ege	ej	edge
20.	regreted	regretted	regreded

21.	botm	bottm	bottom
22.	suddn	sudden	sudn
23.	smilling	smileing	smiling
24.	once	onc	ons
25.	voys	voic	voice
26.	sandey	sandy	sande
27.	faster	fastir	fastr
28.	shortist	shortust	shortest
29.	widen	wyden	widden
30.	stoping	stopping	stopeing

APPENDIX B

DETAILS OF ITEM SELECTION IN TEST 1

DETAILS OF ITEM SELECTION IN TEST 1

1. fops

Carrier phrase. I have two fops.

a) fopse — This is a plausible phonetic rendition if the morphological structure indicated in the carrier phrase is ignored.

b) fops — This is the correct form of spelling the plural of fop ⟶ /fɔps/.

c) fopes — This choice might indicate that es is perceived as the correct form of spelling the plural. While it is suitable in some contexts, it is not for a word ending in a stop consonant.

2. otches

Carrier phrase: Please give me three otches.

a) otchs — This choice indicates that s is perceived as the correct way of spelling the plural. While it is suitable in some contexts, it is not in a word ending in a sibilant.

b) otchez — This is a plausible phonetic rendition if the morphological structure indicated in the carrier phrase is ignored.

c) otches — This is the correct form for spelling the plural of a word ending in a sibilant.

3. ruds

Carrier phrase: We saw five ruds on the bus.

a) ruds — This is the correct form for spelling the plural of a word ending in a voiced sound.

b) rudz — This is a plausible phonetic rendition if the morphological structure indicated in the carrier phrase is ignored.

c) rudes — This choice indicates that es is perceived as the correct way of spelling the plural. While it is suitable in some contexts, it is not in a word ending in a sound other than a sibilant.

4. flays

Carrier phrase: He needs ten flays.

a) flaze — This is a plausible phonetic rendition if the morphological structure indicated in the carrier phrase is ignored.

b) flayes — This choice indicates that es is perceived as the correct way of spelling the plural. While it is suitable in some contexts, it is not for a word ending in a free vowel, other than ī/aI/.

c) flays — This is the correct form of spelling the plural of words ending in a free vowel, other than ī/aI/.

5. smies

Carrier phrase: I hit four smies.

a) smies — This is the correct form of spelling the plural of a word ending in ī/aI/. The i for y alternation

is an orthographic consideration.

b) smys. This choice indicates that s is perceived as the correct way of spelling the plural. While it is suitable in some contexts, it is not in a word ending in ī/aI/.

c) smize This is a plausible phonetic rendition if the morphological structure indicated in the carrier phrase is ignored.

6. liss

Carrier phrase: Can you give me a liss?

a) liss This is the correct form of spelling final /s/ after a checked vowel in a one-syllable word.

b) lis This is a plausible phonetic rendition if the orthographic convention is not known.

c) lise This choice indicates that se is perceived as the correct form for spelling final /s/. While it is suitable in some contexts, it is not in a word following a checked vowel. It also indicates a lack of knowledge of the marker function.

7. zill

Carrier phrase: Please pass the zill.

a) zil This is a plausible phonetic rendition if the orthographic convention of doubling final l after a checked vowel in a one-syllable word is not known.

b) zill This is the correct form according to above-mentioned

orthographic convention.

c) zile — This choice indicates that le is perceived as the correct form for spelling final l. While it is suitable in some contexts, it is not in a word following a checked vowel. It also indicates a lack of knowledge of the marker function.

8. hape

Carrier phrase: I will hape it tonight.

a) hap — This is a plausible phonetic rendition showing lack of knowledge of the marker function. This is a frequent error noted in the spelling of younger children and children with learning difficulties.

b) hayp — This is a plausible phonetic rendition indicating lack of knowledge of the convention of alternating i for y when it is part of a secondary vowel in the medial position.

c) hape — This is the correct form of spelling ā according to the convention of e marking the vowel correspondence.

9. nike

Carrier phrase: Do you want to nike?

a) nike — This is the correct form of spelling ī/aI/ according to the convention of e marking the vowel correspondence.

b) nik — This is a plausible phonetic rendition showing lack of knowledge of the marker function.

c) nyk — This choice indicates that y is perceived as the

correct form for spelling ī/aI/. While it is suitable in some contexts, it is not the common spelling in the medial position.

10. wap's

Carrier phrase: I have a wap who wears a hat. My wap's hat is blue.

a) wap's This is the correct form for marking the singular possessive.

b) waps This is a plausible phonetic rendition if the morphological structure indicated in the carrier phrase is ignored.

c) waps' This choice indicates that s' is perceived as the correct form of spelling the singular possessive. While it is the correct form for spelling the plural possessive, it does not apply in this instance.

11. waps'

Carrier phrase: I had a wap: Now I have two of them. Both waps' hats are blue.

a) wap's This choice indicates that 's is perceived as the correct form for spelling the plural possessive. While it is the correct form for the singluar possessive, it does not apply in this instance.

b) waps This is a plausible phonetic rendition if the morphological structure indicated in the carrier phrase is ignored.

c) waps' This is the correct form for marking the plural

possessive.

12. quiff

Carrier phrase: That quiff is his.

a) quiff — This is the correct form for spelling initial /kw/ ⟶ qu. The letter q is never used alone, but is always followed by u making a spelling unit qu.

b) qwiff — This choice indicates that qw is perceived as the correct form of spelling /kw/ and also indicates a lack of knowledge of the orthographic convention of u and w alternation.

c) kwiff — This is a plausible phonetic convention indicating a lack of knowledge of the orthographic convention of spelling initial /kw/. kw is a possible spelling of /kw/ over a morpheme boundary, as in backwards.

13. ralled

Carrier phrase: We ralled to work this morning.

a) rallde — This choice indicates that de is perceived as the correct way of representing the past tense. This type of error is frequently noted in the spelling of young children and it may, in some cases, represent a sequencing error.

b) ralled — This is the correct form for spelling the past tense of a verb that ends in a voiced sound (/d/ ⟶ ed).

c) ralld — This is a plausible phonetic rendition if the morphological structure indicated in the carrier phrase is ignored.

14. ladded

Carrier phrase: Yesterday he ladded his coat.

a) laddid — This is a plausible phonetic rendition if the morphological structure indicated in the carrier phrase is ignored.

b) ladded — This is the correct form for spelling the past tense of a verb that ends in an alveolar stop (/əd/ ⟶ ed).

c) laddud — This is another plausible phonetic rendition if the morphological structure indicated in the carrier phrase is ignored.

15. poshed

Carrier phrase: On Sunday we poshed in the park.

a) poshd — This choice indicates that d is perceived as the correct way of representing the past tense, indicating a lack of knowledge of the convention of using ed.

b) posht — This is a plausible phonetic rendition if the morphological structure indicated in the carrier phrase is ignored.

c) poshed — This is the correct form for spelling the past tense of a verb ending in an unvoiced sound (other than /t/) (/t/ ⟶ ed).

16. bouge

Carrier phrase: The bouge is open.

a) bouge — This is the correct form of spelling final /ǰ/, with the e marking the correct correspondence of g.

b) bouj — This is a plausible phonetic rendition, indicating a lack of knowledge of the orthographic convention that does not permit the use of j in final position.

c) boug — This choice indicates that g is perceived as the correct way of spelling /ǰ/. While it is suitable in some contexts, it is not correct in word final position. It also indicates lack of knowledge of the marker function of e for indicating the /ǰ/ pronunciation (soft g).

17. votch

Carrier phrase: I like to votch.

a) voche — This choice indicates that che is perceived as the correct form for spelling /č/, and also indicates a lack of knowledge of the convention of using tch after a checked vowel sound.

b) votch — This is the correct form for spelling /č/ after a checked vowel sound.

c) voch — This choice indicates that ch is perceived as the correct form for representing /č/. While it is suitable in some contexts, it is not after a checked (short) vowel sound.

18. hoffle

Carrier phrase: Where is my hoffle?

a) hoffl — This is a plausible phonetic rendition if the orthographic convention of representing syllabic l /l!/ is unknown.

b) hoffel — This choice indicates that el is perceived as the correct form for the spelling of syllabic l /l!/. While it is suitable in certain contexts, it is not here.

c) hoffle — This is the correct form for spelling syllabic l (/l!/ ⟶ le).

19. bidge

Carrier phrase: Paint the bidge red.

a) bige — This choice indicates that ge is perceived as the correct form for spelling final /ǰ/. While it is suitable in some contexts, it is not following a checked vowel sound.

b) bij — This is a plausible phonetic rendition indicating a lack of knowledge of the orthographic convention that does not permit the use of j in a final word position.

c) bidge — This is the correct form of spelling final /ǰ/ after a checked vowel sound.

20. engatted

Carrier phrase: The men were engatted on Friday.

a) engated — This is a plausible phonetic rendition showing a lack of knowledge of the orthographic convention

of doubling the consonant to preserve vowel quality.

b) engatted This is the correct form for spelling the past tense of the verb engat, where it is necessary to double the final consonant to preserve the preceding checked vowel quality.

c) engaded This is also a plausible phonetic rendition, showing a lack of knowledge of the orthographic convention of doubling the final consonant to preserve the quality of the preceding vowel.

21. hattom

Carrier phrase: That hattom costs a dollar.

a) hatm This is a plausible phonetic rendition showing a lack of knowledge of the orthographic convention which represents syllabic m /m!/ with a vowel letter plus m /m!/ ⟶ Vm, except after /ð/ and /z/.

b) hattm This is also a plausible phonetic rendition showing a lack of knowledge of the convention of spelling every syllable with a vowel.

c) hattom This is the correct form of spelling syllabic m /m!/.

22. ludden

Carrier phrase: A ludden a day keeps the doctor away.

a) luddn This is a plausible phonetic rendition showing lack of knowledge of the orthographic convention which spells every syllable with a vowel.

b) ludden This is the correct form of spelling syllabic n /n!/ (/n!/ ⟶ Vn).

c) ludn — This is a plausible phonetic rendition showing a lack of knowledge of the orthographic convention that spells every syllable with a vowel.

23. kabing

Carrier phrase: He is kabing his brother.

a) kabbɪng — This choice indicates that bb is perceived as the correct form for spelling medial /b/. While it is suitable in some contexts, it is not after a free (long) vowel sound, when the suffix begins with a vowel.

b) kabeɪng — This is a plausible phonetic rendition showing a lack of knowledge of the convention of dropping a marker before adding a suffix beginning with a vowel.

c) kabing — This is the correct form of spelling a medial consonant after a free vowel and before a suffix beginning with a vowel.

24. rance

Carrier phrase: Let's go to the rance.

a) rance — This is the correct form for spelling a non-morphemic final /s/ following a voiced consonant.

b) ranc — This choice indicates that c is perceived as the correct form for spelling /s/. While this is true in some environments, it is not so in word final position.

c) rans — This choice indicates that s is perceived as the correct spelling of final /s/. While it is suitable in some contexts, it is not following a voiced consonant.

25. goice

Carrier phrase: She has a good goice.

a) goys — This choice indicates that s is perceived as the correct spelling of final /s/. While it is suitable in some contexts, it is not following a secondary vowel.

b) goic — This choice indicates that c is perceived as the correct form for spelling final /s/. While it is suitable in some contexts, it is not in word final position.

c) goice — This is the correct form for spelling nonmorphemic final /s/ after a vowel. Here e marks the 'soft' correspondence of c.

26. pendy

Carrier phrase: It is a pendy day.

a) pendey — This is a plausible phonetic rendition if morphological structure indicated in the carrier phrase is ignored.

b) pendy — This is the correct form for spelling adjectival /I/ (/I/ $\longrightarrow$ y).

c) pende — This choice indicates that e is perceived as the correct form for spelling final /I/. While it is

suitable in some contexts, it is not when it is adjectival.

27. jister

Carrier phrase: My boat is jister than yours.

a) jister — This is the correct form for spelling the comparative (/ər/ ⟶ er).

b) jistir — This is a plausible phonetic rendition if the morphological structure indicated in the carrier phrase is ignored.

c) jistr — This choice indicates that r is perceived as the correct form for spelling the comparative /ər/. This error is noted in the spelling of young children.

28. jankest

Carrier phrase: This is the jankest book I ever read.

a) jankist — This is a plausible phonetic rendition if the morphological structure indicated in the carrier phrase is ignored.

b) jankust — This is another plausible phonetic rendition if the morphological structure indicated in the carrier phrase is ignored.

c) jankest — This is the correct form for spelling the superlative (/əst/ ⟶ est).

29. stiden

Carrier phrase: They will stiden the baby.

a) stiden — This is the correct form according to the

orthographic pattern of dropping the e marker when a suffix beginning with a vowel is added.

b) styden — This is a plausible phonetic rendition showing a lack of knowledge of the convention of alternating i for y in the medial word position.

c) stidden — This choice indicates that dd is perceived as the correct form for spelling medial /d/. While this is true in some contexts, it is not following a free vowel.

30. fipping

Carrier phrase — They are fipping very slowly.

a) fiping — This choice indicates that p is perceived as the correct spelling for medial /p/. While it is suitable in some contexts, it is not following a checked vowel, when the suffix begins with a vowel.

b) fipping — This is the correct form for spelling medial /p/ after a checked vowel and before a suffix beginning with a vowel.

c) fipeing — This choice indicates that pe is perceived as the correct form for spelling /p/. While it is suitable in some contexts, it is not following a checked vowel. This choice also indicates a lack of knowledge of the marker function.

APPENDIX C

CORRELATIONAL MATRICES

FOR GRADES 2, 3, 4 AND 5

TABLE 21

Correlational matrix for Grade 2.

	Durrell	Test 1	Test 2	Test 3	Test 1		Test 2		Test 3	
					M	O	M	O	M	O
IQ	.32*	.05	.10	.41**	.09	.12	.09	.09	.35*	.42**
Durrell Spelling Test		.79**	.83**	.89**	.61**	.71**	.78**	.75**	.77**	.90**
Test 1			.75**	.75**	.79**	.93**	.73**	.65**	.68**	.72**
Test 2				.69**	.58**	.72**	.91**	.92**	.58**	.71**
Test 3					.57**	.73**	.67**	.63**	.94**	.95**
Test 1: Morphological						.59**	.64**	.44**	.55**	.53**
Orthographic							.64**	.67**	.63**	.73**
Test 2: Morphological								.72**	.58**	.67**
Orthographic									.55**	.64**
Test 3: Morphological										.78**

* $p < .05$ ** $p < .01$

TABLE 22

Correlational matrix for Grade 3.

	Durrell	Test 1	Test 2	Test 3	Test 1		Test 2		Test 3	
					M	O	M	O	M	O
IQ	.23	.21	.26	.16	.14	.20	.35*	.14	.17	.13
Durrell Spelling Test		.81**	.81**	.77**	.50**	.82**	.67**	.77**	.73**	.74**
Test 1			.72**	.72**	.80**	.84**	.61**	.67**	.64**	.72**
Test 2				.79**	.51**	.70**	.87**	.93**	.73**	.79**
Test 3					.46**	.73**	.66**	.78**	.95**	.96**
Test 1: Morphological						.54**	.51**	.41**	.40**	.47**
Orthographic							.54**	.69**	.66**	.72**
Test 2: Morphological								.63**	.60**	.66**
Orthographic									.71**	.77**
Test 3: Morphological										.82**

* $p < .05$ ** $p < .01$

TABLE 23

Correlational matrix for Grade 4.

	Durrell	Test 1	Test 2	Test 3	Test 1 M	Test 1 O	Test 2 M	Test 2 O	Test 3 M	Test 3 O	Word Meaning	Paragraph Meaning
IQ	.57**	.62**	.51**	.52**	.42**	.56**	.55**	.45**	.46**	.36**	.02	.57**
Durrell Spelling Test		.62**	.58**	.70**	.45**	.54**	.63**	.52**	.55**	.60**	.08	.37*
Test 1			.60**	.61**	.80**	.80**	.58**	.53**	.60**	.47**	.41*	.29
Test 2				.53**	.35*	.61**	.90**	.90**	.47**	.40**	.17	.17
Test 3					.42**	.55**	.54**	.46**	.90**	.85**	.20	.36*
Test 1 Morphological						.28	.42**	.27	.40**	.38*	.29	.14
Orthographic							.50**	.58**	.55**	.38*	.35*	.30
Test 2 Morphological								.72**	.48**	.44**	.16	.21
Orthographic									.38*	.30	.07	.18
Test 3 Morphological										.68**	.20	.35*
Orthographic											.15	.13
Word Meaning												-.03

* $p < .05$ ** $p < .01$

TABLE 24

Correlational matrix for Grade 5.

	Durrell	Test 1	Test 2	Test 3	Test 1		Test 2		Test 3		Word Meaning	Paragraph Meaning
					M	O	M	O	M	O		
IQ	.63**	.24	.40*	.58**	.06	.32*	.11	.59**	.24	.60**	-.23	.62**
Durrell Spelling Test		.53**	.58**	.79**	.34*	.58**	.38*	.58**	.44**	.78**	-.07	.74**
Test 1			.62**	.57**	.85**	.92**	.47**	.56**	.47**	.51**	-.07	.46**
Test 2				.61**	.45**	.63**	.85**	.77**	.45**	.55**	.04	.58**
Test 3					.41**	.59**	.48**	.53**	.70**	.90**	-.22	.69**
Test 1												
Morphological						.58**	.40**	.33*	.46**	.32*	.04	.24
Orthographic							.43**	.62**	.39*	.56**	-.11	.55**
Test 2												
Morphological								.36*	.54**	.33*	.13	.43**
Orthographic									.25	.56**	-.11	.56**
Test 3												
Morphological										.34*	.06	.45**
Orthographic											-.30	.65**
Word Meaning												-.11

* $p < .05$ ** $p < .01$