ABSTRACT

THE INFLUENCE OF AFFECTIVITY ON ADOLESCENT JUDGEMENT

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The study examines the way in which affective involvement influences the efficiency of problem solving in students who have reached the Piagetian stage of formal operations. Sixty female adolescents attempted to solve two kinds of reasoning problems paired in logical difficulty but different in that one problem of each pair evoked strong emotional feeling while the other was relatively neutral in affect. The results provide evidence that adolescent affectivity does influence cognitive functioning significantly and thereby effects horizontal décalage at this stage. Moreover, it was found that such interference does not decrease with age, as this décalage is still evident in late adolescence.

L'influence de l'affectivité sur le jugement de l'adolescent

RÉSUMÉ

L'étude montre de quelle manière l'émotivité influence la faculté de résoudre les problèmes chez les étudiants qui ont atteint le niveau piagétien d'opérations formelles. Soixante adolescentes ont essayé de résoudre deux types de problèmes basés sur le raisonnement. Ces problèmes étaient similaires quant à leur difficulté logique mais différents car un problème par catégorie suscitait de fortes réactions émotives et l'autre ne touchait qu'à des sentiments relativement neutres. Les résultats mettent en évidence le fait que l'affectivité de l'adolescent influence le processus cognitif de manière significative et par conséquent affecte le décalage horizontal à ce niveau. Et qui plus est, on a trouvé qu'une interférence de la sorte ne diminue pas avec l'âge mais que ce décalage est toujours présent vers la fin de l'adolescence.

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CHAPTER I

THE PROBLEM

Jean Piaget characterizes the stage of formal operations by the capacity to think on a purely hypothetico-deductive level. At this stage, the use of reflective thought enables the adolescent to divorce his thinking from the manipulation of physical or concrete objects and to use, intuitively, the processes of formal logic in the solution of problems. This makes it possible to accept hypothetical propositions in a detached manner without allowing personal attitude and opinion to influence reasoning; it allows a high degree of objectivity in thinking and resistance to subjectivity even in the presence of strongly held discordant beliefs.

Also evident with the transition to the formal operational stage are innovations of an affective nature. The adolescent often seems to be awed or overwhelmed by the potential of his mental powers. Faith and confidence in the omnipotence of his thought carry him beyond the bounds of reality and grant him unlimited power to transform the world. At this stage, the adolescent enters society "filled with generous sentiments and altruistic or mystically fervent projects and with disquieting megalomania and conscious egocentricity" (Piaget, 1967, p. 66). Hence, adolescent affectivity manifests itself in a preoccupation with the 'self'; it encourages an adherence to personal perspective at the expense of objective reality.

Implicit in these features of the formal operational stage is the possibility that the cognitive and affective facets of adolescent development reflect an incongruence between their parallel, indissociable processes. At least for a time, the stage of formal operations appears to

represent a battleground of conflicting interests. It would seem that while the cognitive forces of hypothetico-deductive thought propose a detached, objective point of view, the affective powers behave in opposition to this by displaying, simultaneously, an egocentric reliance on the subjective. Victim of this dichotomy, the adolescent's ability to alienate himself from the influence of his affective processes when called upon to exercise his developing powers of reason is seemingly threatened. It is on this issue that the present study focuses its attention. The primary purpose of the inquiry, therefore, is to investigate some of the ways in which affectivity may interfere with logical thought and prevent its effective use.

As a corollary to this proposition, further attention is focused on the 'stage-orientated' aspect of this problem. Acknowledged by Piaget's theory of stages is the property of 'consolidation' which defines a preparation-achievement pattern of development within each successive level of cognitive functioning. This characteristic justifies a sporadic early use of tenuous and fragile, incompletely organized cognitive structures, allowing newly acquired skills to progress, with time, toward a fully matured 'structure d'ensemble'. Piaget's concept of 'horizontal décalage', or temporal displacement, elucidates this property further by proclaiming that, although an individual may be capable of thinking on a particular level, he will not necessarily do so at all times or in all situations. An unpredictable barrier or resistance may prohibit, temporarily, the uncategorical application of the respective stage operations to all intellectual tasks. Cognitive and affective maturation, through the processes of equilibration, are expected to provide the resolution of this stalemate. In light of these stage-related aspects of Piaget's developmental theory, the relevance

of such properties to the present problem is an additional consideration of this study. A secondary purpose, therefore, explores the possibility that affective interference in cognitive functioning is a temporal incongruence producing horizontal décalage at this stage.

In summary, the purpose of this thesis is twofold: it investigates the proposition that affectivity influences the capacity to reason formally; and, it examines the contention that this influence is responsible for the phenomenon of horizontal décalage at the stage of formal operations.

CHAPTER II

REVIEW OF THE LITERATURE

The Stage of Formal Operations

This study is concerned with some of the thought processes of adolescents at the level of what Jean Piaget calls the 'stage of formal operations'. For him this stage, developing in most children between the ages of 11 or 12 and 15 or 16, represents the culmination of intellectual maturity. Characterized by hypothesis building and testing and scientific reasoning, these 'hypothetico-deductive' thought processes 'reflect' a true understanding of the laws of nature. For, while formerly caged in a concrete world manipulating physical objects to arrive at legitimate theories, the adolescent is now able to formulate hypotheses based on a series of 'possible' relations of data and then, through logical analysis, to deduce which of these factors is compatible with the evidence and does, in fact, provide the necessary verification of the problem.

> ... the logical operations begin to be transposed from the plane of concrete manipulation to the ideational plane, where they are expressed in some kind of language (words, mathematical symbols, etc.), without the support of perception, experience, or even faith.
>
> (Piaget, 1967, p. 62)

The hypothetico-deductive character of formal operational thought, therefore, requires a distinct degree of abstraction; reliance must now be placed on the 'possible' at the sacrifice of the 'real'. Explained by Piaget (1969):

> Formal deduction consists in drawing conclusions, not from a fact given in immediate observation, nor from a judgment which one holds to be true

> without any qualification (and thus incorporates into reality such as one conceives it), but in a judgment which one simply assumes, i.e., which one admits without believing it, just to see what it will lead to.
>
> (Piaget, 1969, p. 69)

In short, the formal operational thinker changes the direction of concrete-operational thought and adopts a cognitive strategy which attempts to determine reality within the context of possibility. This capacity presupposes the fulfilment of two prerequisites. The adolescent can effect a detachment from the personal point of view, or from the point of view of the moment; he can relinquish personal opinions and beliefs and sever all ties with the attributes of reality as he has experienced it in order to reconstruct it as the manifestation of a lawful system. Subjective thought can now be regarded as an object meriting no better than equal introspection and reflection. Also, capable of accepting a foreign point of view, the adolescent can sustain this plane of mere assumption without surreptitiously returning to private belief or to the point of view of the moment.

> To be formal, deduction must detach itself from reality and take up its stand upon the plane of the purely possible, which is by definition the domain of hypothesis. In a word, formal thought presupposes two factors, one social (the possibility of placing oneself at every point of view and of abandoning one's own), the other, which is connected with the psychology of belief (the possibility of assuming alongside of empirical reality a purely possible world which shall be the province of logical deduction).
>
> (Piaget, 1969, p. 71)

In essence, the fulfilment of these capacities truly liberates adolescent thought. Freed from the chains of concretisms, the formal operational thinker need no longer confine his attention to empirical reality. With the realm of the abstract available to him, the adolescent can now accept and manipulate pure assumption, the validity of which is only provisional.

In so doing, he intuitively extracts the structure of an argument from its content and submits its form to logical analysis, fully aware that conclusions logically derived from the hypothetical have a validity independent of their factual truth.

As idealistic as this may sound, however, in their application to real life the construction and execution of thought processes are never quite so 'cold-blooded'. For, as Inhelder and Piaget (1958) state:

> Formal thinking is both thinking about thought ... and a reversal of relations between what is real and what is possible... These are the two characteristics - which up to this point we have tried to describe in the abstract language appropriate to the analysis of reasoning - which are the source of the living responses, always so full of emotion, which the adolescent uses to build his ideals in adapting to society.
>
> (Inhelder and Piaget, 1958, pp. 141-142)

Or, as Piaget (1950) says on another occasion:

> Logic itself does not consist solely of a system of free operations; it expresses itself as a complex of states of awareness, intellectual feelings and responses, all of which are characterized by certain obligations whose social character is difficult to deny, be it primary or derived.
>
> (Piaget, 1950, p. 163)

Developing synchronously with cognition, an affective facet of development describes the evolution of the personality and its emergence into society. Piaget has only rarely discussed the characteristics of affective development per se, mainly because he sees cognition and affectivity, or "personal-emotional" reactions, as interdependent in functioning - "essentially two sides of the same coin". Thus, used in the broadest sense to cover feelings, emotions, desires, interests, values, et cetera, affectivity can be separated from cognition for discussion purposes, but is considered a parallel, indissociable, complementary facet of development.

> Affective life, like intellectual life, is a continual adaptation, and the two are not only parallel but interdependent since feelings express the interest and value given to actions of which intelligence provides the structure... Personal schemas, like all others, are both intellectual and affective. We do not love without seeking to understand, and we do not even hate without a subtle use of judgment. Thus when we speak of 'affective schemas' it must be understood that what is meant is merely the affective aspect of schemas which are also intellectual.
>
> (Piaget, 1951, pp. 205-206)

On another occasion Piaget (1960) explains:

> ... I would say that affectivity is the regulation of values, everything which gives a value to the aim, everything which releases interest, effort, etc., and then I would say that cognitive functions are the total of structural regulations.
>
> (Piaget, 1960, p. 131)

As an 'extra-cognitive' adaptation then, affectivity provides the motivating element of cognitive functioning. In this capacity it influences the selection of reality content upon which the structures will operate as well as the rate at which the thought processes adapt.

> As the dynamic or energizing aspect of intellectual life, affectivity can influence intellectual functioning, it can speed it up or slow down intellectual development - but 'it does not of itself engender cognitive structures, nor does it modify the structures in whose functioning it intervenes' (Piaget, 1954, p. 5)[1].
>
> (Mischel, 1971, p. 317)

As a byproduct of this cognitive-affective alliance is a behavioural characteristic which appears at the outset of the stage of formal operations and consequently distinguishes adolescence from adulthood. In his attempt to reconcile his newly acquired mental abilities and the surround-

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[1] Being unavailable in English translation, this source is used here as it has been cited and interpreted by Mischel (1971).

ing environment, the early adolescent is confused by the disequilibrium typical of the transition to every new stage and has difficulty adopting a realistic perspective. In the words of Inhelder and Piaget (1958):

> ... when the cognitive field is again enlarged by the structuring of formal thought, a ... form of egocentrism comes into view. This egocentrism is one of the most enduring features of adolescence ... the adolescent not only tries to adapt his ego to the social environment but, just as emphatically, tries to adjust the environment to his ego... The result is a relative failure to distinguish between his own point of view ... and the point of view of the group which he hopes to reform... But we believe that, in the egocentrism found in the adolescent, there is more than a simple desire to deviate; rather, it is a manifestation of the phenomenon of lack of differentiation... The indefinite extension of powers of thought made possible by the new instruments of propositional logic at first is conducive to a failure to distinguish between the ego's new and unpredicted capabilities and the social or cosmic universe to which they are applied ... the adolescent goes through a phase in which he attributes an unlimited power to his own thoughts so that the dream of a glorious future or of transforming the world through Ideas ... seems to be not only fantasy but also an effective action which in itself modifies the empirical world.
>
> (Inhelder and Piaget, 1958, pp. 343-346)

Hence, with the transition to this stage, the formal operational thinker is involved in an idealistic crisis. The metamorphosis he is experiencing often encourages the adolescent to be primarily concerned with himself. His "high-level" egocentrism in Flavell's (1963) terms:

> ... takes the form of a kind of naive idealism, bent on intemperate proposals for reforming and reshaping reality and -- here the 'omnipotence of thought' characteristic of all egocentrism - with an immoderate belief in the efficacy of its thought coupled with a cavalier disregard for the practical obstacles which may face its proposals.
>
> (Flavell, 1963, p. 224)

Thus we see that the implementation of formal thought in adolescence is, initially, egocentric in nature. The adolescent has difficulty differentiating between the many possible perspectives or points of view; he operates according to 'assumptive realities', but, immersed in an inner life, he is tempted to reduce everything to a subjective viewpoint.

> It is the metaphysical age par excellence; the self is strong enough to reconstruct the universe and big enough to incorporate it.
>
> (Piaget, 1967, p. 64)

Diminishing with the gradual attainment of equilibrium toward mid-adolescence, this 'cognitive egocentrism' is overcome by transformations within the two inseparable spheres of development which engendered it. On the cognitive plane, it is resolved by a gradual differentiation between the adolescent's own preoccupations and the thoughts of others; a reconciliation is brought about between formal thought and reality. In a state of equilibrium, the adolescent understands that the proper function of reflection is not to contradict but to predict and interpret experience. Simultaneously, on the affective plane, adolescent egocentrism is overcome by a gradual integration of the feelings of others with the personal emotions of the adolescent. Highly personal and idiosyncratic ideas gradually become sociocentric, environmentally validated and tested ideas. In Piaget's (1967) words:

> ... successive constructions always involve a decentering of the initial egocentric point of view in order to place it in an ever-broader coordination of relations and concepts, so that each new terminal grouping further integrates the subject's activity by adapting it to an ever-widening reality... Parallel to this intellectual elaboration we see affectivity gradually disengaging itself from the self in order to submit, thanks to the reciprocity and coordination of values, to the laws of cooperation.
>
> (Piaget, 1967, p. 69)

The characteristic of egocentrism, fostered by a new, untried field of cognitive activity, thus subsides with the eventual mastery of this unexplored cognitive terrain.

> ... there is egocentric thought just as there is egocentric affect, and there is socialized thought adapted to reality just as there is socialized affectivity adapted to reality.
> (Piaget, 1954, p. 191 as cited by Mischel, 1971, p. 319)

Because of this, it has been suggested (Elkind, 1968) that investigations of egocentrism prove a valid starting point for attempts to reconcile the cognitive and affective processes; egocentrism helps to tie the cognitive types of behaviour peculiar to a stage to social attitude and personality and reflects the affective aspects of thought and behaviour. The 'ebb and flow' of egocentrism across ontogenetic development, therefore, may be seen as an expression of the general equilibrium process which Piaget imputes to cognitive evolution.

> Reason which expresses the highest form of equilibrium reunites intelligence and affectivity.
> (Piaget, 1967, p. 70)

The Property of Consolidation and the Concept of Horizontal Décalage

Consideration is now given to the temporal implications posited by these characteristics of formal operational thought. A closer look at some of the 'stage-related' aspects of development may elucidate any seeming incongruences and rationalize their presence within the framework of Piaget's developmental theory. For, although the stage of formal operations represents the culmination of intellectual processes, it is by no means indicative of an instantaneous 'giant step' into adulthood. No pri-

leged status exempts this particular stage from the conditions imposed on all levels of development. This stage, like the others, relies on "progressive construction without entailing total preformation" (Piaget, 1970, p. 710). Thus, the emergence of fully matured formal operations as a completed, functional 'structure d'ensemble' comes only after all the customary properties of 'stage' have been accounted for.

The property of stage most relevant to the present study is the concept of consolidation. Proposed by Piaget as an essential characteristic of stage development, this property dictates that each specific period of development, or stage, must always involve at once an aspect of preparation and achievement. This relationship appears intrinsic to a given stage 'n' whose function is to complete the phase 'n-1' and to prepare for the phase 'n+1' (Piaget, 1960, pp. 13-14). It is described by Flavell (1963) in the following manner:

> In the preparation period, the structures which define the stage are in the process of formation and organization. Because of this, behaviour in the initial substage of any stage tends to lack tight organization and stability in so far as it is directed towards those cognitive problems whose solution requires that stage's intellectual structures... When confronted with problems appropriate to the stage-in-process, the child's cognitive activities are likely to reflect a mélange of organized but inappropriate earlier structures and the halting and sporadic use of as yet incompletely organized new structures. The preparatory phase, with its flux and instability, gradually gives way to a later period in which the structures in question form a tightly knit, organized, and stable whole. It is only in this phase of achievement, of stable equilibrium, that the structures defining the stage exist as ... 'structures d'ensemble'...
> (Flavell, 1963, p. 21)

Flavell and Wohlwill (1969) characterize the property of consolidation by a "competence-automation" distinction. The competence phase assures that

the capacities to perform the thought processes peculiar to a stage are generally available, but they will not always be fully automized. Citing the research of Nassefat (1963) as evidence of this property, Flavell and Wohlwill (1969) conclude:

> ... even restricting ourselves to a single grouping, or domain, we can expect to find departure from intertask consistency during the transition period. For it is precisely during this period in which the newly emerging structures are in process of formation that the child's responses may be expected to oscillate from one occasion to the next, to be maximally susceptible to the effects of task-related variables, and accordingly to evince a relative absence of consistency.
>
> (Flavell and Wohlwill, 1969, p. 95)

All new mental acquisitions, therefore, may be so fragile and tenuous at first that performance is inconsistent or highly probablistic; a temporary stabilization phase enables primitive structures to undergo gradual consolidation in an effort to attain their functional maturity.

This property of stage is more succintly elucidated from a negative viewpoint by the concept of horizontal décalage dormant within it. This theory of time lag or temporal displacement denotes a chronological differentiation between the acquisition and/or development of any two cognitive tasks that obey identical structural laws. That is, a cognitive structure characteristic of a particular stage can be applied to task A, however only later can the same organization of operations be extended to task B; a recurrent pattern in development is recognized when similar cognitive abilities occur at different ages across the ontogenetic span.

Pinard and Laurendeau (1969) suggest that when considering the various relations between operations Piaget (1941)[1] recognizes four types of hori-

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[1] Being unavailable in English translation, this source is used here as it has been cited and interpreted by Pinard and Laurendeau (1969).

zontal décalage. He distinguishes in his analysis of the different forms of possible relations among the operations or actions of a given set of operations, as a function of whether they bear on one specific concept or on different concepts. Discrepancies between separate concepts such as the differences between the concepts of mass, weight, and volume recognized with respect to the conservation of quantity manifested at the concrete operational stage (Piaget and Inhelder, 1940; Elkind, 1961a; Elkind, 1961b) are considered an 'analogous' type of décalage. On the other hand, when operations bear on one concept, three types of 'intraconcept' relations are possible. According to Pinard and Laurendeau (1969), the 'identity' type designates relations among operations bearing on a specific object that is subjected to various deformations of greater or lesser magnitude as in an experiment of conservation; the 'vicariousness' type refers to operations bearing on several homogeneous objects that are capable of being assembled in a common whole, as is the case with plasticine, because of the possibilities of substitution or vicariousness of their respective parts; and, the 'correspondence' type refers to operations dealing with heterogeneous objects if, although not unitable in a simple whole (as for example in the conservation of a quantity of plasticine or the conservation of a quantity of water), these objects lend themselves to comparisons or correspondences among their respective parts. The likelihood of horizontal décalage, Piaget believes, is inversely proportional to the closeness of these relationships between operations. The 'analogous' type of relationship witnessed in the conservation tasks is therefore deemed most likely, followed by 'correspondence', 'vicariousness', and 'identity'. The 'correspondence' type of horizontal décalage is contended by Pinard and Laurendeau (1969) to be most critical since, if heterogeneity of objects alone brings numerous or strik-

ing time lags, then typical behaviours and levels could lose their identity and the lines of demarcation could become severely blurred.

Any more explicit cause or justification for the phenomenon of horizontal décalage remains vague. Pinard and Laurendeau (1969) rationalize that:

> Even if the operations pertaining to a common concept develop at the same time, it is normal that certain conditions of a perceptual and intuitive nature, relative to a specific content and themselves variable according to the physical and sociocultural experiences of the child, would bring about certain temporal deviations.
> (Pinard and Laurendeau, 1969, p. 35)

Or, as Flavell (1963) points out:

> Task contents differ in the extent to which they resist and inhibit the application of cognitive structures.
> (Flavell, 1963, p. 23)

Piaget contends that it is impossible to propose a general theory of décalage, but offers the following explanation.

> Time lags are always due to an interaction between the person's structures on the one hand, and the resistances of the objects on the other... Since resistances are unpredictable and can only be explained after the event, specific causes remain vague.
> (Piaget, 1971, p. 11)

However, a number of factors have been empirically studied with respect to the conservation tasks at the concrete operational stage which have generally substantiated the suggestions cited above. The relevance of the competence of the child as measured by age, sex, I.Q., M.A., and vocabulary has been shown by Goldschmid (1967); the influence of experience with related task contents has been shown by Uzgiris (1964); the relevance of knowledge has been illustrated by Gagné (1968) and by Inhelder and Sinclair (1969); while Hooper (1969) has shown the strong influence of perceptual factors. These factors are also evident in various cross-cultural studies (Goodnow and Bethon, 1966; Peluffo, 1967, Kimball, 1968) which also reveal the

existence of horizontal décalage.

In conclusion, these asynchronisms represent the fact that whereas it might be convenient and useful to label an individual with a particular set of cognitive structures, it must be recognized that he will not necessarily be capable or inclined to perform within that structural set in all tasks.

> The attainment of a cognitive stage merely means that an individual under optimum conditions becomes capable of behaving in a certain way which was impossible before.
>
> (Inhelder, 1960, pp. 125-126)

Quantitative differences are evident within the realms of qualitative structures. Thus, not always in the same stage of development with regard to different substantive areas, the individual may display various levels of achievement even though he is confronted with problems involving similar mental operations. Consequently, the existence of horizontal décalage is indicative of heterogeneity where one might have foreseen only homogeneity. Once again, the resolution of this negative characteristic of development appears to rest solely in the hands of time. The stabilizing character of the property of consolidation is expected to reconcile these discrepancies so that the individual will behave more consistently and uniformly. The movement from structural disequilibrium to structural equilibrium is recognized, as always, "when novel stimulation can be used by the system without either disrupting its activity or necessitating a structural differentiation" (Elkind, 1961a, p. 556).

Relevant Research

Given the foregoing theoretical foundation, this review now directs its attention to a discussion of the research which has probed the nature of the cognitive-affective relationship. First, it is necessary to give

brief consideration to the relevance of content or subject matter. As we have seen, the central factor operating in the cognitive processes is the ability to objectify one's interpretation of a mental task. This, of course, demands alienation or isolation from the subjective, from the intrapersonal affects of attitude and belief. It would appear, then, that the success of this isolation, and thus the effective exercise of reason, would be dependent upon the presence of affective temptation or provocation. Because of this the factor of content which intervenes between the cognitive and affective processes and characterizes their interaction is of prime importance. It is the content or subject matter of a problem which assumes the function of mediator between the thinker and the intellectual task or operation; it is that which is perceived, scrutinized, and manipulated or acted upon. As such, the content of a mental task may provide a climate of willing and enthusiastic response, or it may be of such a nature as to posit resistance and inhibit the thinker from harmonious interplay with his task. Therefore, in determining the affective response so vital as the motivating or energizing element of cognitive functioning, content may be recognized as a middleman between the cognitive and affective processes. Studies of the development of the cognitive processes appear to confirm this contention that content variability does indeed reflect a resistance on the part of affective factors to the successful practice of cold, calculating logic even at the formal operational stage.

Although it has been shown repeatedly that formal operational tasks have a large general component and are therefore unifactorial (Hughes, 1965; Lovell, 1961; Jackson, 1965; Lovell and Butterworth, 1966; Lovell and Shields, 1967), other findings express contention that the factor of content is highly relevant at this stage. Stone (1966) in a study of "intersituational

generality" determined empirically that there is a trend for increased generality of application at the stage of formal operations. Subsequently, Bart (1971a) challenged the unifactorial nature of formal operational tasks. In a study conducted on ninety scholastically above-average adolescents, using four Piagetian formal thought tasks, three formal operational reasoning tests and another test of verbal intelligence, evidence was found that formal operational skills have a bifactorial structure: the first is a substantial formal operational factor; the second reveals a content factor which separates the tasks from the individual tests. Bart concludes, therefore, that since formal operational skills set in a given content were found to be unifactorial these skills can be meaningfully classified according to their contents.

These results are strongly supported by other studies which similarly illustrate the relevance of content to cognitive development. Formal thought does not seem available evenly across all content areas and there do exist individual differences in the age of appearance of formal thought with respect to a given content. For example, it has been shown by Hallam (1967) that formal thought in history comes late, at 16 or 16 1/2, presumably because in this content area pupils are required to analyse actions and events far removed from their immediate environment.

Of more specific relevance to the present study are investigations of intra-individual variability in the kinds of content which can be dealt with by formal operational thought. Here, various factors of an affective nature are proposed as determinants of the effective use of formal operational thought. It has been suggested (Lovell, 1970) that formal operational behaviour initially manifests itself with respect to content with which the thinker is familiar and knowledgeable and which, for him, has credibility. Indeed, Peel (1960) in support of previous claims showed that when

these criteria were lacking, instruction with that particular content improved results of formal judgement. Lunzer (1965) contends that logical necessity and initial belief sometimes work together, as for example in the falling bodies on an inclined plane experiment, but that initial belief will usually override as it does in the pendulum experiment where weight is intuitively believed to be a factor. The influence of personal experience and preconceived belief of this nature Lunzer defines as "dissonance" between the way concepts have been acquired and the way they should be interpreted in the light of new situations. Belief or verisimilitude is thus offered as a factor relevant to the successful functioning of formal thought processes. Closely related to this are the findings of Donaldson (1963) who showed that the content of problems and interference of personal experience will result in arbitrary errors as factors of the development of thought. Such errors were considered short-cuts from correct assumptions to erroneous conclusions, generally caused by accidental associations with irrelevant aspects of the problem. Factors producing these errors include the content of the problem and the subject's capacity to resist the pressure of impulses and drives. Shrinkage of such errors with age, however, confirmed that emotional or affective pressure and egocentrism interfered less and less with cognitive adaptation and thus reduced the likelihood of these resistances. In close agreement, a study by Case and Collinson (1962) demonstrated that formal thought in language showed regression to an intuitive level to be high where personal experience and verbal repertory were lacking. This affective interference was found to be only temporary, however, as the level of formal thought was maintained after 14 years of age. Inquiries into the relevance of the affective factor of interest have produced contradictory results. Elkind (1961a) in exploration of the factors influencing the con-

servation of volume has shown that junior and senior high school students who failed to judge volume conservation did so because they failed, in Piaget's terms, to dissociate their subjective sensorimotor conceptions of weight and volume from their objective, logico-mathematical conceptions. Elkind suggests that the early formal operational thinker will be selective, guided by interests as to what problematic areas he will attend to. He postulates that the adolescent will manifest formal operations initially with respect to topics of interest and only later with matters of disinterest - a factor which he proclaims will have a decreasing effect with an increase in experience at the formal operational stage. Contrary to this hypothesis, Dienes and Jeeves (1965) found evidence that the ability to induce and determine the group structures embedded in tasks, a challenge comparable to formal operational skills, is not related to the level of interest in the tasks. In further investigation, Bart (1971b) was similarly denied such evidence. In an attempt to measure the effect of interest on horizontal décalage at the stage of formal operations three formal reasoning tests and an interest test were administered to ninety scholastically above-average adolescents. As a result, it was determined that level of interest has little or no association with the level of formal reasoning throughout the stage of formal operations.

Bearing in mind the evidence evinced from the above analyses of various affective factors as they pertain to cognitive development, consideration now turns to the encompassing effect of attitude as a determinant of effective logical thought. E.A. Peel (1971) in his many explorations of adolescent judgement recognizes an ambiguity in the nature of familiar and relevant content as it relates to logical reasoning. Though he confirms the assumption that concrete, familiar material can make reasoning tasks easier,

he also admits to its detrimental side effects. "Judging is involved whenever we are in a situation for which we have no ready-made answer ... decision turns on what the judger wants to fulfil" (Peel, 1971, p. 19); therefore, although he believes that curiosity and interest are high when there is a highly identifiable, familiar orientation to the content of a problem, at the same time Peel sees this relevance as the "graveyard" of much problem solving. While some studies show that situations which are familiar to adolescents will arouse more considered, imaginative judgements (Bulwer, 1957; Best, 1967), Peel contends that when the features of problems are linked to experience and insights of the thinker, imaginative and comprehensive thought can easily result in an invocation of independent ideas and consideration of the problem in personal terms. The opening for personal bias made by such subject matter frequently jeopardizes mature patterns of judgement and results in the distortion of a less mature, concrete or circumstantial reasoning. In such cases, it would appear that what Peel terms "level 2" judgements, though totally content dependent, would prove more advantageous to the successful solution of the problem. Peel holds faith, however, that the urge to resolve these inconsistencies will be felt by the thinker and, in the move toward equilibrium, he will be compelled to come to intellectual terms with his environment.

Although Peel's faith in the resolution of the ambiguity of content is substantiated by the concept of horizontal décalage and the consolidation property of stage development within the framework of Piaget's theory, a preponderance of empirical investigations of the conflict of affectivity and cognition conducted on adults deems such confidence highly optimistic. With the understanding that the findings of such studies may not be generally applied to the thought patterns of adolescents, their implications are worthy

of consideration in this review.

As early as 1925 G.B. Watson through an experiment of "The Measure of Fairmindedness" showed conclusively that a subject could have so strong an emotional reaction to the content of a statement that he closes his mind to its validity. He found that when the reasoner made an error in logical judgement it was not because he did not see clearly a difference between the statement and the facts placed above it; it was rather that he had so strong an emotional reaction toward the statement that he required very little provocation to register his conviction that the statement was true. As Thouless points out in Straight and Crooked Thinking, (1974, p. 55), "the general structure of the argument is hidden under a multitude of words and made difficult to recognize by the fact that the argument is about something on which we feel strongly". The holder of opinion, generally quite unconscious of the irrational grounds for his belief, constructs an apparently rational set of reasons for confirming his beliefs. In this manner, attitude will function as a context for related material and will single out 'wanted' data. Mary Henle (1955; 1962) proclaims that, because of this, motivational processes alter cognitive functioning in accordance with the nature of the material on which they act. While agreeable content is better understood and accepted and therefore is more easily recalled and received in a more friendly manner, a strong attitude toward or involvement with this material may be responsible for difficulty in accepting the logical task. Similarly, Bruner, Goodnow and Austin (1956) in their classic Study of Thinking involving selection strategies in concept attainment concur that much of human reasoning is supported by a thematic process whose principal feature is its pragmatic rather than its logical structure. Most human beings perform logical operations with more confidence and precision

when the material about which they reason is concrete and familiar, because here verisimilitude provides a way of checking upon reality. However, these investigations agree that, while attainment of concepts with materials that are meaningful and amenable to familiar forms of groupings may be advantageous in directing one toward a reasonable conclusion, just as readily, it may only predispose one to accept arguments that are preferred in the sense of being most congruent with one's own attitudes and values, in spite of the fact that they are both incorrect logically and readily detectable as such when they appear in neutral form. The many studies of Wason and Johnson-Laird (1971) share these evaluations. They suggest that the nature of the material of intellectual tasks would seem so decisive in terms of whether subjects exercise rational thought that different principles may govern reasoning with familiar as opposed to unfamiliar material. Concrete, familiar material is again recognized to help appreciation and generate and assess hypothetical corrections between facts and to encourage a natural facility in making assumptions and deductions; but, when affective factors come into play, while concurrence can make reasoning easy, conflict results to the detriment of logical performance. Subjects tend to accept a given conclusion which they find congenial to be validly derived because bias has narrowed their field of appreciation and blinded the thinker to the obvious. A state of 'emotional inhibition' prevails to such an extent that judgements are based only on what can be personally accepted. Jeeves (1957), in fact, has shown that even a simple emotionally loaded word coming in the course of a sequential narrative which has to be extrapolated to the point of completion can radically affect the direction in which the completion will be effected; while McGuire (1961) produced evidence that even 'wishful thinking' produces deviation from logical thinking.

Further empirical evidence of affective interference with cognitive processes has been presented by an array of studies testing the syllogistic reasoning ability of adults. Janis and Frick (1943) revealed that attitude toward the conclusions of concrete syllogisms constitutes a factor which determines faulty judgement. This finding was substantiated by the work of Morgan and Morton (1944) who concluded that the only circumstance under which we can be relatively sure that the inferences of a person will be logically correct is when they lead to a conclusion which has already been accepted. Although the methodology used in this and similar studies was challenged by Henle and Michael (1956), subsequent findings corroborate this evidence. Lefford (1946), again having shown that attitude influences reasoning in the direction of personal conviction, acknowledged that the internal forces of ego are at war with human rationale: emotional attitudes are the arch-enemies of objective and clear thinking. To remain objective, he contends, the forces of personality and reason must be separated. Thistlethwaite (1950) in an analysis of attitude and structure as factors in the distortion of reasoning confirmed that as the structure of the form becomes increasingly compatible with prejudiced responses, the degree of relative distortion increases. The greatest distortion occurred on those structures most consonant with the relevant attitudes of the subjects, rather than on the most ambiguous structures. Feather (1963) elucidated further by showing that evaluation of an argument is consistent with attitude in that it is positively related to the strength of the attitude and to intolerance of inconsistency, and negatively related to the level of critical ability. In keeping, Kaufmann and Goldstein (1967) illustrated that syllogisms with positively and negatively affective conclusions result in more errors than syllogisms with neutral conclusions, with distor-

tion again moving in the direction of personal opinion. Indeed, the only study of this nature producing discordant evidence of the influence of affective factors on reasoning ability was conducted by Thouless (1959). Using two forms of tests with each of two groups of subjects, he found that while adult subjects did tend to be influenced by their prejudices, a group of graduate students showed no significant influence in either direction by the expected effect of personal attitude on judgements as to the soundness of the arguments presented. In summary, as Thouless (1974) has pointed out, the strong influence of affective factors in the contamination of cognitive functioning at the adult level is acknowledged even by Darwin who is alleged to have kept a notebook in which he recorded all facts or ideas which were opposed to his conclusions - otherwise, he forgot them!

Questions Arising from the Literature

The foregoing analysis of the theoretical issues relevant to the current research and the empirical findings presented in relation to them give rise to a number of questions regarding the relationship which exists between the cognitive and affective facets of development at the formal operational stage. The primary purpose of this inquiry is to investigate some of the ways in which adolescent affectivity may influence the effective use of formal operational thought. With respect to this proposition, an essential question asks if there is a significant discrepancy between the ability to reason logically when presented with problems which allow the thinker to remain uninvolved or unconcerned with the conclusions presented in these problems and the same ability when presented with equally difficult problems which arouse emotional involvement with the conclusions presented.

The literature shows that this is a frequently recognized tendency brought about by the instability and disequilibrium of immature cognitive structures, accompanied by egocentrism, at earlier stages of development; similarly, this is shown to be the case in studies conducted on adults. However, the position of the adolescent with regard to this issue remains merely speculative.

In addition, should it be the case that affectivity does influence adolescent judgement, then further consideration is due the nature of this interference. Therefore, this inquiry also questions the contention that the accuracy of adolescent reasoning depends upon the extent to which the conclusions marked by logic coincide with the beliefs already held by the reasoners. That is, the study asks if the subjects will be influenced favourably toward correct judgements when the problems arrive at conclusions which are in sympathy with their personal convictions or, on the other hand, if they will be influenced unfavourably when the conclusions presented are antagonistic to their beliefs. In effect, this would result in a tendency to accept invalid conclusions which are accompanied by emotion when they are concordant with strongly held beliefs and to reject similarly toned valid conclusions when they are discordant with such beliefs. The answer to this question would confirm the conditions under which affectivity acts in harmony with cognitive functioning and the circumstances under which it distorts formal thought.

A second purpose of this study is to investigate the possibility that the interference of the affective processes with cognitive functioning is essentially a temporal incongruence. This consideration seeks an answer to yet another question. Should this research provide evidence that the accuracy of formal reasoning is subject to the influence of affective factors

and is therefore not available uniformly, this affirmation would attest that affectivity has an effect on a confirmed ability and thus determines horizontal décalage at this stage. In consequence, the question arises as to whether or not the tendency of this influence to jeopardize the efficiency of formal thought, as speculated earlier, prevails in inverse proportion to the age of the problem solvers. Is the failure to generalize reasoning ability, representing a temporal displacement or horizontal décalage, the result of a resistance attributable to the factor of age? This final consideration, therefore, questions the extent to which the influence of affectivity will decrease with age and cease to obstruct logical thought later in the formal operational stage once the cognitive structures characteristic of this stage have matured.

CHAPTER III

EXPERIMENTAL PROCEDURE

This experiment was designed to analyse the influence of affectivity on adolescent judgement. A reasoning test consisting of pairs of equivalent problems was used to compare the capacity of female adolescents to execute logical judgements deduced from neutral content to the same ability when jeopardized by the provocation of affective content. A separate opinion questionnaire was then used to corroborate the interference of any apparent partiality on the part of the subjects. The successful use of this method and variations of it by Janis and Frick (1943), Feather (1963), Lefford (1946), Thistlethwaite (1950), and others, confirms its effectiveness as a means of examining the relation which exists between cognition and affectivity and suggests its appropriateness at the stage of formal operations.

The Sample

The sample used in this study consisted of sixty female students representing a three year age span, who were enrolled in grades 9, 10, and 11 at a private girls' day-school. From a large number of students who showed willingness and keen enthusiasm to participate in the experiment, the sixty volunteers were selected in accordance with the availability of their free time and the necessary age requirements of the study.

To meet the demands of this research, three age ranges were equally represented, in keeping with the acknowledged chronological expectations of the stage of formal operations. Age group 1, the youngest group of twenty students, ranged from 14;6 to 15;5 years; age group 2, the middle

age group, ranged from 15;6 to 16;5 years; while age group 3, the eldest age category, ranged from 16;6 to 17;7 years. Table 1 shows the exact distribution of ages within these three categories. It was anticipated that while all of these adolescents were likely to have acquired the structural characteristics typical of the formal operational stage, beginning usually at 11 or 12 years of age, their respective age-related structures would represent varying degrees of stabilization and consolidation and thus differ with regard to their functional maturity. This age classification allowed for the subjects to be studied collectively and in accordance with the expectation of age-related discrepancies in performance.

The private girls' school which the students in this sample attend was founded in 1909 and has a population of approximately two hundred and seventy-five students. It is well-known for its maintenance of high educational standards and its traditional emphasis on the cultural and social adaptation of its students. Being 'independent', the school relies primarily on substantial tuition fees for its financial support, although it has of late been deemed "in the public interest" and does receive some governmental assistance. The overall population of the school, therefore, is drawn in the most part from the upper and higher middle class strata of society who appear to share a privileged socio-economic status and a respect for a high calibre of education. In addition, all applicants to the school are stringently screened and, despite the fact that specific entrance requirements have altered through the years with changes in the administrative personnel, final acceptance to the school implies the successful fulfilment of prescribed academic criteria and standards. It is regrettable, however, that no precise measure of intelligence could be obtained and included as a variable in the present study. All subjects selected for participation in this ex-

TABLE 1

SAMPLE DISTRIBUTION BY AGE AND AGE GROUP

AGE GROUP 1		AGE GROUP 2		AGE GROUP 3	
Age	N	Age	N	Age	N
14; 6	3	15; 6	3	16; 6	4
14; 8	3	15; 7	1	16; 8	2
14;10	1	15; 8	3	16;10	3
14;11	4	15;10	1	16:11	1
15; 0	4	15;11	1	17; 0	1
15; 1	2	16; 0	4	17: 1	2
15; 2	1	16; 1	3	17; 2	1
15; 4	1	16; 2	2	17; 4	1
15; 5	1	16; 3	1	17; 5	1
		16; 4	1	17; 6	2
				17; 7	2
N = 20		N = 20		N = 20	

periment are Canadian citizens who share an Anglo-Saxon ethnicity. Similarly, all subjects are English speaking and were not expected to experience difficulty of a linguistic nature. Although eight percent of the students had had by this time a brief exposure to the syllogistic form in a geometry course, none had had any training in the analysis or solution of such problems, or any encounter with the principles of formal logic.

Delimitations

The seeming conformity suggested by the relative consistency of academic and socio-economic status represented by this school population imply that the sample was a very homogeneous one with respect to cultural background, scholastic standing and, probably, intelligence. It is recognized that this homogeneity inevitably limits the generalizability of any conclusions drawn from this inquiry. Recently a paper by Cochrane and Duffy (1974) castigated researchers for using the kind of sample which was used here, saying that using an aggregate of volunteers as the subjects of inquirymakes it impossible to generalize any findings to the total population. However, this paper provoked a rejoinder from Eysenck (1975) in the same Journal in which, citing Popper (1972), he pointed out that:

> Cochrane and Duffy are basing their case on a quite erroneous conception of scientific method, using an inductive method which has been out of date for many, many years.
>
> (Eysenck, 1975, p. 195)

It is Eysenck's belief that a random sample is not mandatory of scientific research; in certain circumstances it may be appropriate, in others not. As he explains, modern methodology proceeds by theory and justification. A specific theory is proposed which has testable consequences; in so far as these consequences are in fact discovered when an empirical test is made,

then in so far does this theory survive. If a theory does not specify subgroups to which it does not apply, then the assumption is that it applies universally. When there has been no discrimination at the time of selection between different members of the total population, then a sample is random unless it is specifically selected by reference to the variables to be tested. The hypotheses in most psychological experiments contain the assumed minor premise that for the purposes of a particular experiment all persons at risk of selection are equal. This probably being the case of the present research, then clearly any selection of subjects may be said to have been a random one.

Nonetheless, it is acknowledged that, because previous studies (Elkind, 1961a; Stone, 1966; O'Brien and Shapiro, 1968) have produced contradictory evidence as to sex differences in the performance of adolescents with respect to formal operational skills, conclusions based on the findings in this research may be limited in the breadth of their application in so far as this sample comprised solely female subjects.

The Measuring Instruments

The measuring instruments used in this experiment consist of a forty-item reasoning test which was used as an instrument of formal reasoning ability and an opinion questionnaire intended as a corresponding measure of affectivity. These may be found in Appendix A.

The Reasoning Test

The nature of the present study demanded the use of a reasoning device which allows for the constancy of form or structure and at the same time permits variability in the subject matter. By this means, the logical difficulty of a problem could be held constant while the effects of changes in

content could be measured. The medium of problem presentation which was selected to provide this flexibility was the syllogism. The successful use of this reasoning device in previous research on adults, referred to earlier, confirmed the practicality of this medium and also enabled the present findings to be compared readily with the results of former studies on this theme.

The reasoning test includes thirty-two problems of the standard syllogistic form, structured by two premises and a conclusion, which were formulated by the author along the lines suggested by previously mentioned works. These syllogisms constitute two groups of sixteen pairs which are identical in formal structure, linguistically similar, and are matched in mood or tone and in length. In addition, each pair has a corresponding distribution of negatives, universals and quantifiers to insure equal difficulty and the reduction of differential atmosphere effects (Woodworth and Sells, 1935). Eight such pairs of problems are valid, conforming to the formal rules of logic; the remaining eight are invalid, containing simple logical fallacies.

However, while agreeing in all technical aspects, the problems within each pair differ essentially with respect to content. The content of one group of sixteen problems is of a 'neutral' or non-affective nature which defines subject matter which is familiar and credible in its relevance to personal experience, but which is selected to encourage objectivity through its concentration on basic, rudimentary aspects of the environment. This classification of content, therefore, is unlikely to arouse an affective response and thus aims at avoiding the tendency to become subjective in the solution of these problems. The topics presented in these problems, many of which were suggested by Lefford (1946), include: weather forecasting, the filing of income tax returns, garage maintenance, longevity, architec-

tural design, and so forth. Examples of first a valid and then an invalid problem of this type follow:

> Farm lands which receive a great deal of sunlight must be irrigated to insure sufficient moisture. San Andreas, California is a farming area which receives a great deal of sunlight. The farm lands of San Andreas, therefore, must be irrigated to insure sufficient moisture.
>
> Health experts claim that Niacin is a valuable dietary supplement for children who are suffering from malnutrition. Physically active children with bright, rosy cheeks are not suffering from malnutrition. Therefore, Niacin is not a valuable dietary supplement for physically active children with bright, rosy cheeks.

Responses to these test items were expected to reveal the capacity to use formal operations effectively, when allowed to execute the principles of cold, uncontaminated logic in an objective manner.

In contrast, the respective pairs to these neutral problems embody content of an 'affective' nature, emotionally toned so as to arouse personal feelings and beliefs and thus foster a subjective reaction. As assurance that these problems would, in fact, have this potential to entice or tap the personal biases of all subjects with as much consistency and uniformity as possible, the affective content of these problems was restricted to topics which pertain specifically to the immediate school environment common to all. The aim, therefore, was to choose topics which would hold particular interest for the students of this school and about which all subjects were likely to hold an opinion. The choice of these items as to their highly identifiable and controversial nature was discussed extensively with colleagues on the teaching staff before the final selection of topics was made. The chosen topics, in keeping with the customs peculiar to this school environment, reflected the controversies of the times and include issues such as

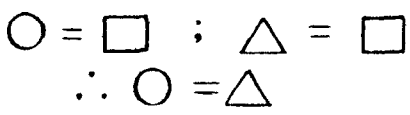
the wearing of a school uniform, dining-room procedures, the singing of hymns in morning assembly, the merits of all-girl schools, the election of the school Prefects, and so forth. As examples of these problems, the respective pairs to the neutral problems cited above follow:

> Students who assume added responsibilities within the school should be granted special privileges in return for their services. The school Prefects assume added responsibilities at E.C.S. The school Prefects, therefore, should be granted special privileges.
>
> The writing of formal, end-of-year examinations is a valuable academic experience for students who have not clearly mastered their year's work. Students with year's averages above 80% have clearly mastered their year's work. Therefore, the writing of formal, end-of-year examinations is not a valuable academic experience for students with year's averages above 80%.

It was the intent that the controversial nature of such content, in its power to provoke personal bias, would guarantee susceptibility to affective interference and posit a threat to the successful exercise of the processes of logical reasoning. It is worthy of mention, however, that because the chosen topics dealt with in these problems are sufficiently controversial and elicit mixed feelings on the part of the students, no preconfirmed attempt could be made to sway subjects necessarily toward an erroneous judgement. It was equally likely that a subject would agree with a conclusion and be favourably influenced as disagree and be unfavourably influenced. The content of such topics was intended only to register an effect on reasoning ability and chance remained as to whether this effect would prove beneficial or detrimental, in keeping with personal opinions and beliefs. Responses to this group of problems were expected to indicate the extent to which the subjects allowed affective influence to contaminate the objective thought processes simultaneously used in the solution of the corresponding neutral problems.

The effectiveness or reliability of this pairing system was appraised by interested colleagues and university professors who passed judgement on the equivalence of the neutral and affectively-toned instances. The correlation coefficients presented in Table 2 substantiate the effectiveness of this method. As may be seen here, no significant association exists between responses to the neutral and affective problems for all but one pair of the sixteen problems. Despite the logical equivalence of the problems, the manipulation of content appears to have produced an effect on the solution of these two types of problems.

As well as these thirty-two paired items, eight extraneous reasoning problems of spatial, algebraic and nonsense types are included in the test battery. These included problems such as the following:



All TEKSASTOPSES are MALPIGIENSES. No MALPIGIENSES are TIESCAMBIA. Therefore, no TIESCAMBIA are TEKSASTOPSES.[1]

It was hoped that these slight deviations from the normal or routine pattern of the reasoning test would act as a relief mechanism by providing the stimulation of variety and would also help, to some extent, to disguise the purpose of the experiment. Performance on these items was not to be taken into consideration in the analysis of the results.

To guard against the likelihood of the subjects detecting the pairing system employed by this methodology and to avoid order of presentation effects, all reasoning problems were mimeographed individually and the thirty-two paired problems were randomized in test booklets with the extraneous items intervening regularly.

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[1] This problem is taken from the work of Wilkins (1928), p. 15.

TABLE 2

PEARSON PRODUCT-MOMENT CORRELATION BETWEEN RESPONSES TO THE NEUTRAL AND AFFECTIVE PROBLEMS
(N = 60)

Questions	Correlation Coefficients	Exact Significance Level	*
1	.1881	0.150	N.S.
2	.0292	0.825	N.S.
3	.0370	0.779	N.S.
4	.0338	0.798	N.S.
5	-.0955	0.468	N.S.
6	-.1216	0.355	N.S.
7	-.0785	0.551	N.S.
8	-.0312	0.813	N.S.
9	-.0357	0.787	N.S.
10	-.0236	9.858	N.S.
11	-.2285	0.079	N.S.
12	.0580	0.660	N.S.
13	-.2245	0.085	N.S.
14	.2102	0.107	N.S.
15	.0844	0.521	N.S.
16	.3515	0.006	S.

* Items labelled 'S' are significant at the .05 level of probability; items labelled 'N.S.' are not significant at this level.

The Opinion Questionnaire

To confirm the concordance or discordance between the personal feelings of the subjects and the conclusions presented in the reasoning problems, an opinion questionnaire was constructed and employed as a measure of correspondence. This questionnaire comprised an exact reiteration of the conclusions drawn in the sixteen affectively-toned problems, presented as statements with an affirmative-negative option enclosed in parentheses. The opinion questionnaire items corresponding to the affective problems cited earlier appear on the questionnaire sheet as follows:

> The school Prefects (should, should not) be granted special privileges.
>
> The writing of formal, end-of-year examinations (is, is not) a valuable academic experience for students with year's averages above 80%.

Responses to this inventory were interpreted as indication of the personal attitudes and beliefs of the subjects concerning the validity or invalidity of the controversial issues discussed in the problems and thereby enabled the matching or comparing of affective influence and logical judgement. Respective responses which indicated a high instance of 'valid' answers to the problems and personal 'affirmation' of the feelings expressed by these conclusions, or 'invalid' answers with corresponding opinions of personal 'negation', were interpreted to suggest that partiality or personal opinion may have entered into the formation of the respective judgements. Whereas, on the other hand, combinations of 'valid'-'negation' and 'invalid'-'affirmation' were taken to imply that partiality on the part of the subjects probably did not enter into the formation of the judgements. Through this means, it was possible to determine the extent to which previously executed judgements were influenced by subjective commitment. Table 3 shows the cor-

TABLE 3

PEARSON PRODUCT-MOMENT CORRELATION BETWEEN RESPONSES TO THE AFFECTIVE PROBLEMS AND OPINION QUESTIONNAIRE
(N = 60)

Questions	Correlation Coefficients	Exact Significance Level	*
1	.5866	0.001	S.
2	.3504	0.006	S.
3	.5021	0.001	S.
4	.3760	0.003	S.
5	.3196	0.013	S.
6	.4812	0.001	S.
7	.6235	0.001	S.
8	.2722	0.035	S.
9	-.4668	0.001	S.
10	-.1115	0.397	N.S.
11	-.3645	0.004	S.
12	-.5313	0.001	S.
13	-.3939	0.002	S.
14	-.1416	0.281	N.S.
15	-.4784	0.001	S.
16	-.3066	0.017	S.

* Items labelled 'S' are significant at the .05 level of probability; items labelled 'N.S.' are not significant at this level.

relation between responses to the affective problems and the corresponding opinion questionnaire items. While it is recognized that the opinion questionnaire has only face validity, the data presented in this table substantiate the claim that the instrument is a reliable measure of partiality. As is shown, all but two items, numbers 10 and 14, show correlations which are significant at the .05 level of probability.

For the purpose of testing the clarity and/or ambiguity of these measuring instruments a pilot study was conducted on a similar sample of twenty students. Because no formal means of testing for the reliability and validity of the test items was feasible, it was hoped that this practice-run would depict any salient weaknesses in the construction of the test. However, the results of this preliminary study did confirm that the selected items appeared to produce a differential effect between performance on the two groups of problems, showing a noticeable discrepancy in the responses to the paired items. The strongly emotional reaction elicited regarding the nature of the affective problems also contributed to the overall satisfaction with the reasoning instrument. In addition, this pilot study was used as an aid in determining the length of the test, or the number of test items and corresponding opinionnaire items which could be adequately covered in the time available for their administration. As a result, it confirmed the selection of forty reasoning problems and the respective questions regarding personal opinion as the number of items which could be answered reasonably in approximately one hour.

Administration of the Test and Questionnaire

The experiment was conducted on groups ranging from ten to fifteen subjects in five sessions at times most convenient for the participants.

Before beginning, the subjects were asked to think of a code name or symbol, perhaps a telephone number, which they would use in place of their names to label their test materials. This was done for purposes of anonymity and afterward enabled the effective matching of the test materials for scoring procedures. Upon distribution of the test booklets, the subjects were informed that the first part of this experiment was a test designed to measure their ability to reason, or to make logical judgements; they were asked to confront the task with concentration and sincerity. The subjects were instructed to read each passage carefully and to judge whether or not the conclusions arrived at are justified by the statements given in support of them. Having assessed the logical development of each argument in this manner, they were to record their judgements by writing 'valid' if they found the conclusion soundly deduced, or 'invalid' if they detected faulty reasoning, on the blank provided on each page. Warning was given that the arguments presented in the problems covered a broad range of topics, several referring to school life, and that, in every instance, the premises must be accepted as fact. It was emphasized that, despite personal opinion on these issues, it was the logic of the argument to which attention must be paid and not the subject matter. Finally, the subjects were requested to record their ages to the nearest month on the covers of their test booklets.

Without forewarning, following the completion and submission of the reasoning test booklets, the subjects were issued the opinion questionnaire. Confirmation was given that this was an entirely separate task intended simply to gather personal feelings regarding the issues discussed in the reasoning test. For this reason, the subjects were discouraged from any attempt to maintain consistency between the two test materials and were asked

to disregard the recall of any discrepancies and/or concurrences of response. The students were urged to be totally honest in their responses to this questionnaire and were assured confidentiality. Instructions requested that they circle the option which most accurately conformed to their personal opinions on the issues raised.

Although no rigid time limit was imposed, and the participants were advised to work at their own chosen pace, both parts of this experiment were completed by the majority of the subjects within three-quarters of an hour and an hour, which was the time tentatively allotted.

Upon completion, the reaction of the students toward the experiment was highly favourable. The subjects showed sincere interest and avid curiosity regarding the purpose and the 'secret' of the study and eagerly questioned and commented upon various aspects of it. Many of the girls were more than willing to sacrifice the anonymity of their work for the opportunity to discuss the accuracy and interpretation of their answers. Indeed, some even asked permission to attend the following testing session to "try again"! Similarly, several students asked if they could have another test booklet to take home and that they be considered for participation in any similar experiments in the future. The only feelings of disappointment voiced by the subjects were with regard to the opinion questionnaire. Several girls registered chagrin because they were forced to affirm or negate uncategorically an opinion without being allowed to elaborate on or justify their feelings. Middle of the line options such as 'maybe' or 'in some cases' would perhaps have been preferred by these subjects and would not have caused them to feel unfairly limited in their responses. In conclusion, the spontaneous reaction from the subjects involved was so encouraging that, owing to several speculative remarks concerning the "real meaning" of

the study, the incentive was provided to conduct a subsequent experiment on a smaller sample of students shortly afterward. This supplementary experiment is the topic of Chapter VII.

Statistical Analyses Performed

Two packages of computer programmes were used to analyse the data obtained from this experiment: the Statistical Package for the Social Sciences, S.P.S.S., and the Statistical Analysis System, S.A.S.

The 'Codebook' subprogramme of S.P.S.S. was used to compute the number of cases and percentages of correct and incorrect responses to each of the thirty-two reasoning problems as well as for the answers given on the opinion questionnaire. This was done for the responses of the sixty subjects collectively and for the responses obtained within each of the three designated age groups.

Correlation analysis was performed by the 'Pearson Corr' subprogramme of S.P.S.S. which was used to compute standard product-moment correlation coefficients. These showed the strength of association between responses to the neutral and affective problems, and between responses to the affective problems and the opinion questionnaire. A partial correlation programme was also used from this package to measure any potential differential effect produced by age.

A factorial analysis of covariance was performed using the 'Anova' subprogramme of the S.A.S. package to examine performance on the neutral and affective problems attributable to the factors of age, the neutrality-affectivity of content, validity-invalidity, and the interaction between the latter two.

The 'Fastabs' subprogramme of S.P.S.S. was used to obtain the joint

frequency distributions, or crosstabulations, of cases according to the variables classified as significant sources of variance. These frequency distributions were statistically analysed by the chi-square and phi tests of significance.

CHAPTER IV

THE RESULTS

Table 4 shows the percentage of correctly answered questions which have been arranged in pairs with the neutral items above their corresponding affective items. It may be noted that 80.4% of all neutral items were correctly answered against 57.7% of the emotionally-toned affective items. Except in the case of invalid items 9 and 11, on all cases the percentage scoring correctly on the neutral items was higher than that on the affective items. It is also noteworthy that the results on both the neutral and affective problems are higher for the valid items than for the invalid items. These results are shown graphically in Figure 1.

In Table 5 the data have been assembled into a 2 x 2 table classifying the problems into valid and invalid, neutral and affective items. Here we see that the valid items are more frequently answered correctly than the invalid items, with respective means of 77.9% and 60.2%, and the neutral problems are more frequently answered correctly than the affective items with respective means of 80.4% and 57.7%. This table also gives a measure of the relative difficulty of the types of items. Neutral-valid items appear to be the easiest, affectively-toned invalid items the most difficult.

Table 6 shows the percentage of responses to the opinion questionnaire which substantiate concordance or discordance with the conclusions drawn in the sixteen affective problems. For valid problems 1 through 8 the concurrence of personal opinion with the conclusion presented has been indicated by an affirmative response, while for invalid problems 9 through 16 concurrence with the conclusion was represented by a negative response.

TABLE 4

THE PERCENTAGE OF CORRECTLY ANSWERED NEUTRAL AND AFFECTIVE PROBLEMS
(N = 60)

PROBLEMS	VALID								
	1	2	3	4	5	6	7	8	MEANS
NEUTRAL	78.3	93.3	90.0	88.3	98.3	96.7	98.3	95.0	92.3
AFFECTIVE	76.7	30.0	71.7	61.7	65.0	70.0	73.3	60.0	63.5

PROBLEMS	INVALID									OVERALL MEANS
	9	10	11	12	13	14	15	16	MEANS	
NEUTRAL	51.7	46.7	71.7	71.7	61.7	75.0	81.7	88.3	68.5	80.4
AFFECTIVE	53.3	33.3	88.3	51.7	46.7	21.7	71.7	48.3	51.9	57.7

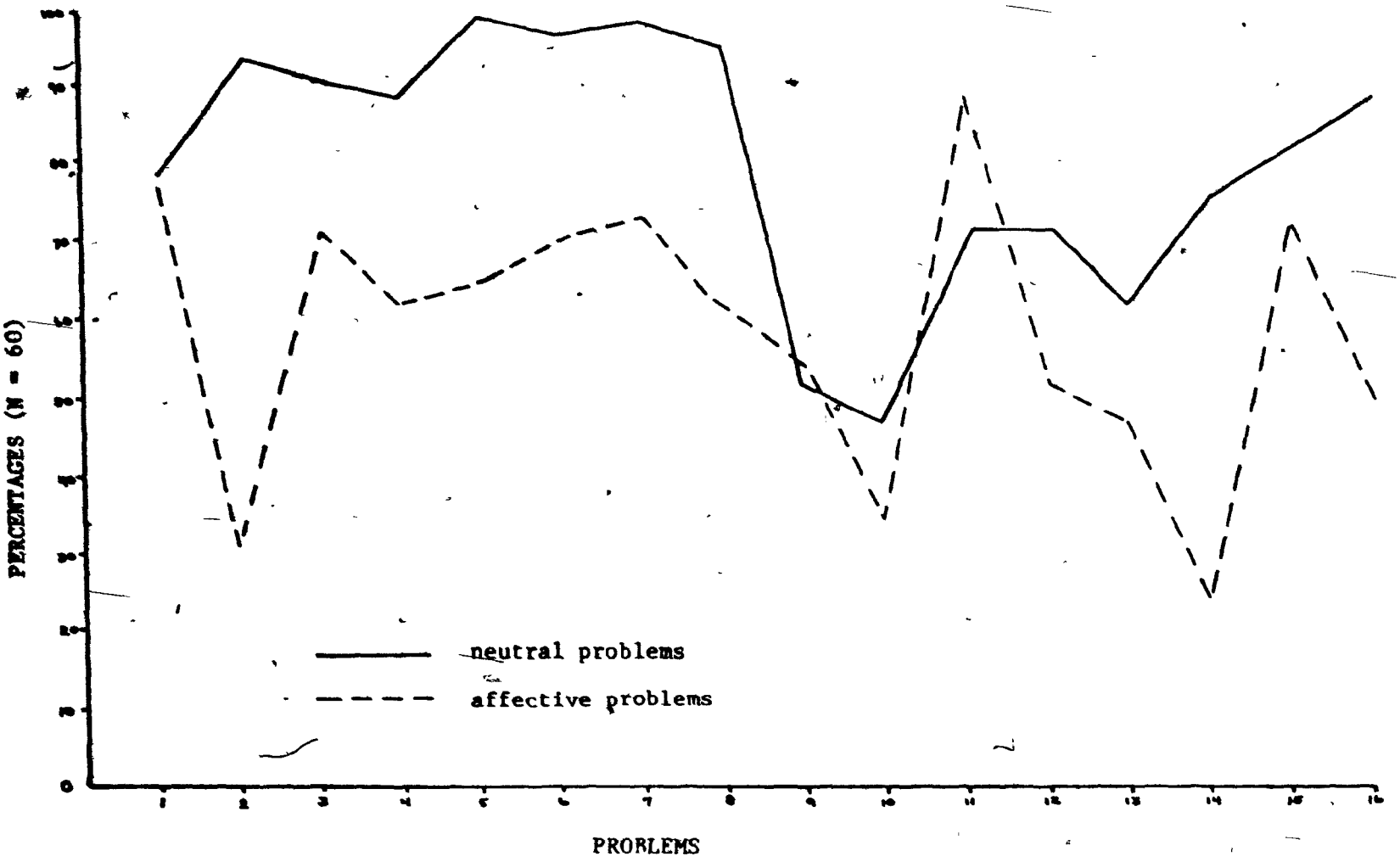

FIGURE 1

THE PERCENTAGE OF CORRECTLY ANSWERED NEUTRAL AND AFFECTIVE PROBLEMS

TABLE 5

THE PERCENTAGE OF CORRECTLY ANSWERED NEUTRAL AND AFFECTIVE, VALID AND INVALID PROBLEMS
(N = 60)

	VALID	INVALID	
NEUTRAL	92.3	68.5	MEAN 80.4
AFFECTIVE	63.5	51.9	MEAN 57.7
	MEAN 77.9	MEAN 60.2	

TABLE 6

OPINION SCALE: THE PERCENTAGE OF RESPONSES TO THE OPINION QUESTIONNAIRE STATEMENTS WHICH CONCUR WITH CONCLUSIONS PRESENTED IN THE AFFECTIVE PROBLEMS
(N = 60)

STATEMENT NUMBER

	1	2	3	4	5	6	7	8
PERCENTAGE OF CONCURRENCE	65.0	5.0	51.7	25.0	55.0	53.3	51.7	10.0

STATEMENT NUMBER

	9	10	11	12	13	14	15	16
PERCENTAGE OF CONCURRENCE	63.3	23.3	81.7	70.0	61.7	20.0	36.7	33.3

CHAPTER V

ANALYSIS OF THE DATA AND INTERPRETATION

A factorial analysis of covariance was used to identify possible determinants of discrepancy in performance on the neutral and affective test items. The factors included were age, validity-invalidity, and content, or neutrality-affectivity. A regression model allows the first variable the greatest potential for effect, while subsequent factors may add to this variance by explaining any residual variance. The results of this analysis may be seen in Table 7. Here it may be noted that even though the factor of age was placed first so as to have the greatest chance of effect, an F value of 0.772 shows that age is not a significant factor at the .05 level of probability. This finding was corroborated by an analysis of correlation and crosstabulation which will be discussed more extensively later in the chapter. As Table 7 indicates, however, all other tested variables have been shown to be significant. It is noteworthy that even though the factor of content was placed last, having the least chance of effect or of causing variance, it proved significant at the .0001 level of probability. These data provide evidence that the differential effect causing discrepancy in performance is produced by the factors of content, validity-invalidity, and their interaction.

The differential effects of these factors may be reviewed in Table 5 of THE RESULTS chapter and are represented graphically in Figures 2a and 2b which chart the respective means of each of the four classifications of problems: neutral-valid; neutral-invalid; affective-valid; and affective-invalid. Figure 2a shows that for both neutral and affective problems

TABLE 7

SUMMARY OF ANALYSIS OF COVARIANCE

SOURCE	d.f.	MEAN SQUARE	F VALUE	PROB > F
AGE	1	0.149	0.772	0.3796
VALIDITY-INVALIDITY	1	15.059	78.253	0.0001
(CONTENT) NEUTRALITY-AFFECTIVITY	1	24.752	128.623	0.0001
INTERACTION OF VALIDITY-INVALIDITY AND CONTENT	1	1.752	9.105	0.0026
ERROR	1915	0.192		

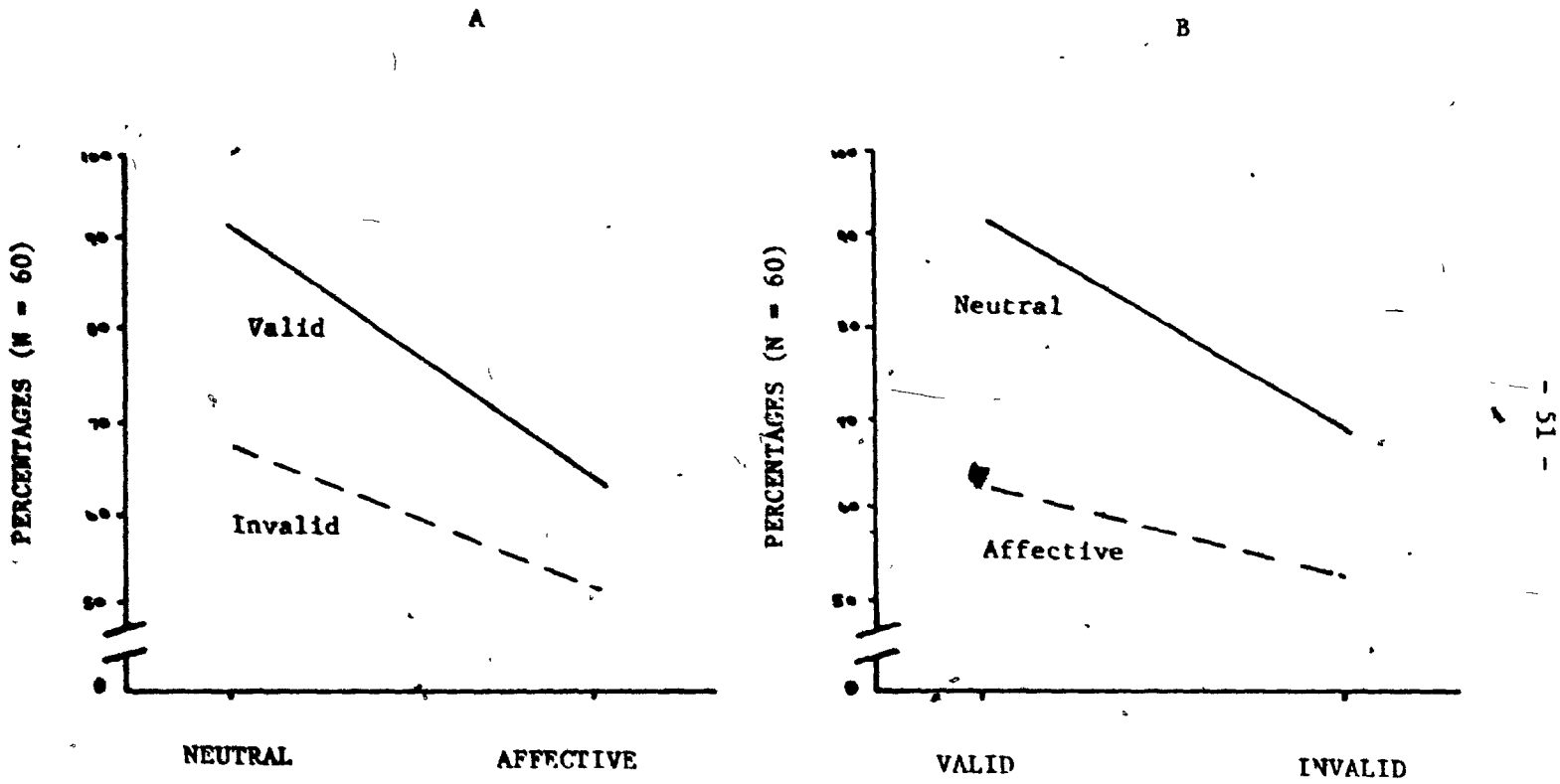

FIGURE 2

THE PERCENTAGE OF CORRECTLY ANSWERED NEUTRAL AND AFFECTIVE, VALID AND INVALID PROBLEMS

the percentage of correctly answered valid problems exceeded the percentage of correctly answered invalid problems, although the discrepancy in performance is not as great for the affective problems. In addition, the percentage of correct responses to valid problems always exceeded the percentage of correct responses to invalid problems. Moreover, for both valid and invalid items there was a drop in the percentage of correct responses in the move from neutral to affective problems. Figure 2b depicts the same data from a different perspective, showing the situation in reverse. Here it may be seen that for both valid and invalid problems the percentage of correctly answered neutral problems exceeded the percentage of correctly answered affective problems, although again the discrepancy in performance is not as great with the invalid problems. Once again, the percentage of correctly answered neutral problems always exceeded the percentage of correctly answered affective problems and for both neutral and affective problems there was a decline in performance from valid to invalid problems. The finding established in Table 5, which confirmed that affective and invalid problems appear to be most difficult, may be offered here as explanation of why discrepancies in performance were not as marked in these two respective areas. It would seem evident that the greater difficulty produced by the factors of affectivity and invalidity tended to reduce the degree of distortion which is so marked on problems of less difficulty. However, it is also noteworthy that in both figures there is indication of a disordinal interaction.

The responses obtained from the opinion questionnaire, which were used to substantiate the personal convictions of the subjects regarding the conclusions presented in the affective problems, made it possible to analyse further the differential effect produced by the factor of content, or neutra-

lity-affectivity. If affective content was a significant factor in the formation of judgement, as these findings seem to indicate, then we would expect that the responses to the opinion questionnaire would register any partiality on the part of the subjects toward the conclusions drawn in the problems which may have influenced decisions regarding the believed validity and invalidity of these problems. It has been suggested that the influence of affective factors on the ability to reason effectively would act in proportion to the concurrence between the conclusions presented in the affective problems and the respective personal opinions held by the subjects toward these conclusions. As has been pointed out in Chapter III, EXPERIMENTAL PROCEDURE, this concurrence is registered by instances of 'valid'-'affirmative' and 'invalid'-'negative' responses to the reasoning test and the opinion questionnaire respectively. Such combinations of responses would imply that partiality or personal conviction may have entered into the formation of judgement. On the other hand, combinations of 'valid'-'negative' and 'invalid'-'affirmative' would be interpreted to imply that partiality probably did not enter into the formation of judgement. Therefore, a comparison of the responses to the affective problems and the opinion questionnaire may be used to show the frequency with which the problems were evaluated as to their validity and invalidity in line with personal opinion. The distributions of the anticipated combinations of responses in the total population were obtained by using the 'Fastabs' subprogramme of the S.P.S.S. computer package. The results are shown in Table 8. As indicated by this table, all but three combinations of responses, test items 8, 10, and 14, are significant at the .05 level of probability. These findings are corroborated by the Pearson Product-Moment correlation coefficients for these items shown in Table 3 of Chapter III, although the correlation analysis shows only two

TABLE 8

CHI-SQUARES OBTAINED FOR RESPONSES TO THE AFFECTIVE PROBLEMS AND OPINION QUESTIONNAIRE
(N = 60)

ITEMS	CHI-SQUARE+	SIGNIFICANCE	*
1	17.84	0.0000	S.
2	4.28	0.0386	S.
3	12.98	0.0003	S.
4	6.79	0.0092	S.
5	4.86	0.0276	S.
6	11.87	0.0006	S.
7	20.59	0.0000	S.
8	2.79	0.0951	N.S.
9	11.20	0.0008	S.
10	0.29	0.5895	N.S.
11	5.31	0.0212	S.
12	14.70	0.0001	S.
13	7.76	0.0053	S.
14	0.50	0.4808	N.S.
15	11.62	0.0007	S.
16	4.41	0.0357	S.

+ Corrected for continuity by using Yates' Correction.

* Items labelled 'S' are significant at the .05 level of probability (d.f. = 1); items labelled 'N.S.' are not significant at this level.

test items, 10 and 14, to be significant at the .05 level of probability. The instances of such combinations of responses, which establish concurrence between judgement and personal opinion, suggest that the ability to judge logically valid and invalid problems depends to a large extent on the personal feelings and beliefs of the subjects regarding the conclusions presented in these problems. The adolescents participating in this experiment did not appear capable, in most instances, of being able to divorce themselves from the affectively-toned nature of content and to analyse the problems effectively according to their form or structure.

Having ascertained, therefore, that partiality does enter into the reasoning processes exercised by the subjects of this study on the affective problems, the overall effect of this influence has yet to be clearly established. A closer examination of these factors is provided by the 'Fastabs' calculations of the anticipated frequency distributions. First, the situation may be viewed from the point of view of correct and incorrect performance on the affective problems related to concordance and discordance of opinion. Figure 3 shows the number of correct responses out of a possible 60 and, of these, the number of corresponding responses to the opinion questionnaire which confirm concurrence with the conclusions presented in the affective problems. It is interesting to note that while differences range from 2 to 30 with a mean of 13.0 only test item 8 does not concur with the parallel sequence of these responses. It is understood, however, that if reasoning is correct, as is the case here, personal feelings and beliefs are perhaps likely to have been irrelevant to those subjects who can exercise the capacity of formal operational skills successfully. This presentation of the data, therefore, shows the performance of both those subjects capable of resisting extraneous interference with cognitive functioning as well as those

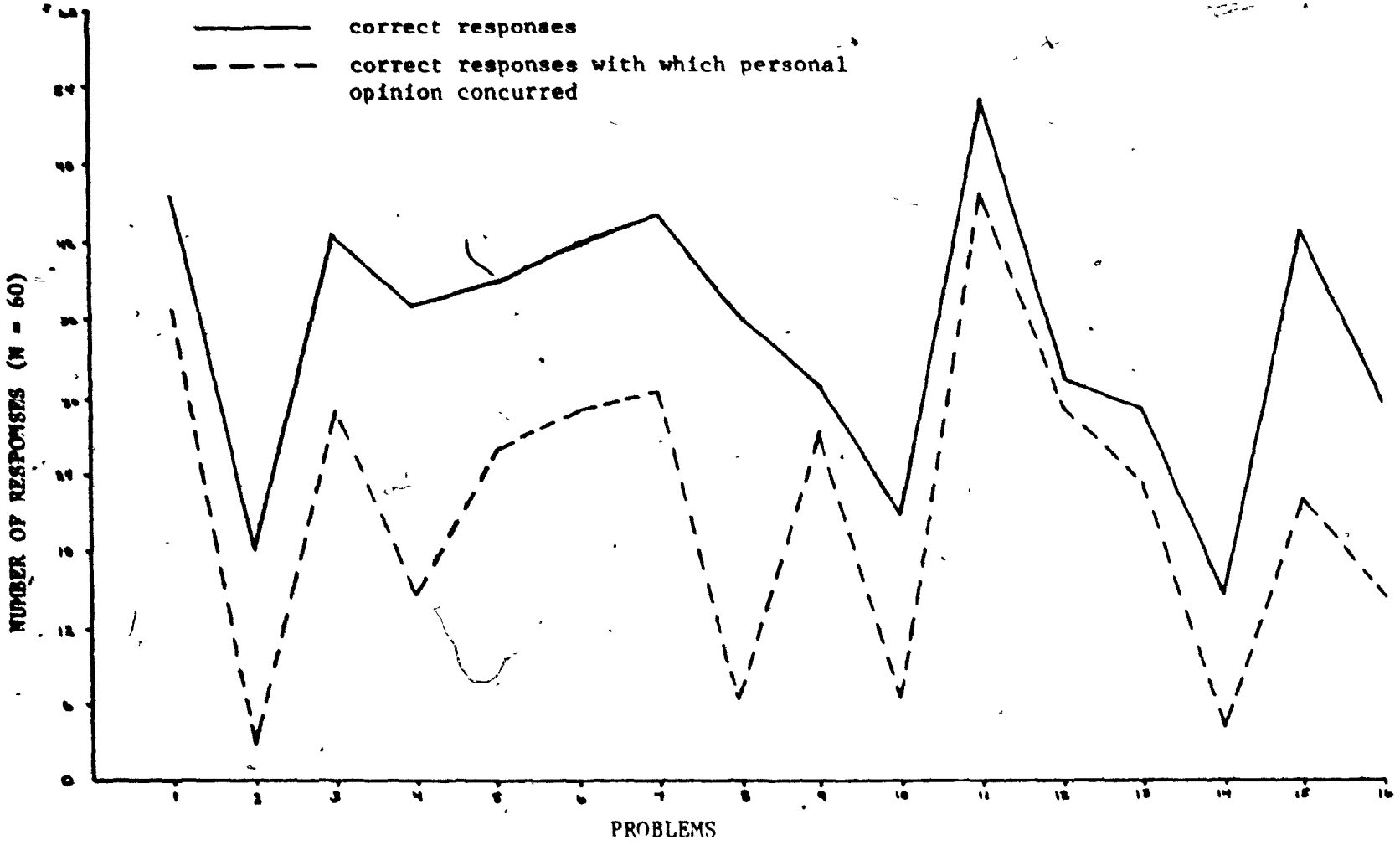

FIGURE 3

THE SYNCHRONY BETWEEN CORRECT RESPONSES TO THE AFFECTIVE PROBLEMS AND CONCURRENCE OF PERSONAL OPINION WITH THE CONCLUSIONS PRESENTED IN THESE PROBLEMS

who have been favourably or beneficially influenced by the interference of affectivity.

Perhaps of more specific relevance is a presentation of the data from the point of view of incorrect responses. Should it be the case, as these results imply, that personal opinion or affectivity has a significant influence on reasoning processes and does, in fact, distort logical thought, an examination of the distribution of errors and the correspondence of personal opinion to these responses is of value. If this contention is confirmed, we would expect on valid problems 1 through 8 a high instance of 'invalid', or incorrect, answers to correspond to opinion questionnaire responses which reveal discordance with the conclusions presented; while on invalid problems 9 through 16 we would expect a high instance of 'valid', or incorrect, responses to correspond to questionnaire responses which register concordance with the conclusions presented. Figure 4 confirms this prediction. It is noted here that incorrect responses to valid problems 1 through 8 corresponded to opinionnaire responses of discordance ranging from 66.7% to 100% with a mean as high as 90%. Similarly, incorrect responses to invalid problems 9 through 16 corresponded to responses of concordance with the conclusions ranging from 55.2% to 100% with a mean of 71.6%. The difference in the means of the valid and invalid problems again is indicative of the greater difficulty of the invalid problems where this trend is reduced. This finding is also displayed in Figure 5 which shows the number of erroneous judgements on each problem and, of these, the number for which responses of non-concurrence with the statements presented as conclusions to the problems were registered on the opinion questionnaire. Differences here range from 2 to 14 with a mean as low as 4.9. Again, where large discrepancies exist they are to be found among the invalid pro-

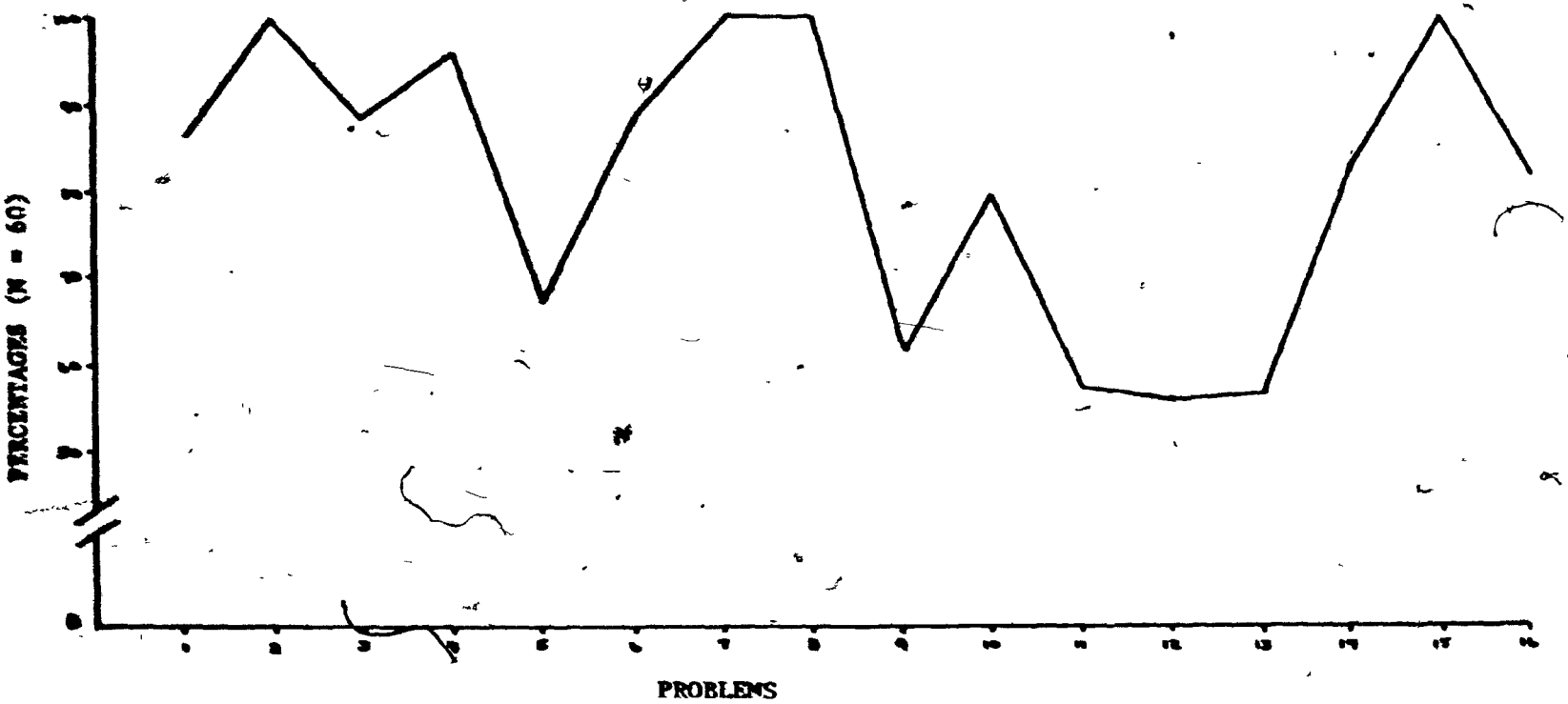

FIGURE 4

THE PERCENTAGE OF INCORRECT RESPONSES TO THE AFFECTIVE PROBLEMS FOR WHICH PERSONAL OPINION WAS DISCORDANT WITH THE CONCLUSIONS PRESENTED IN THESE PROBLEMS

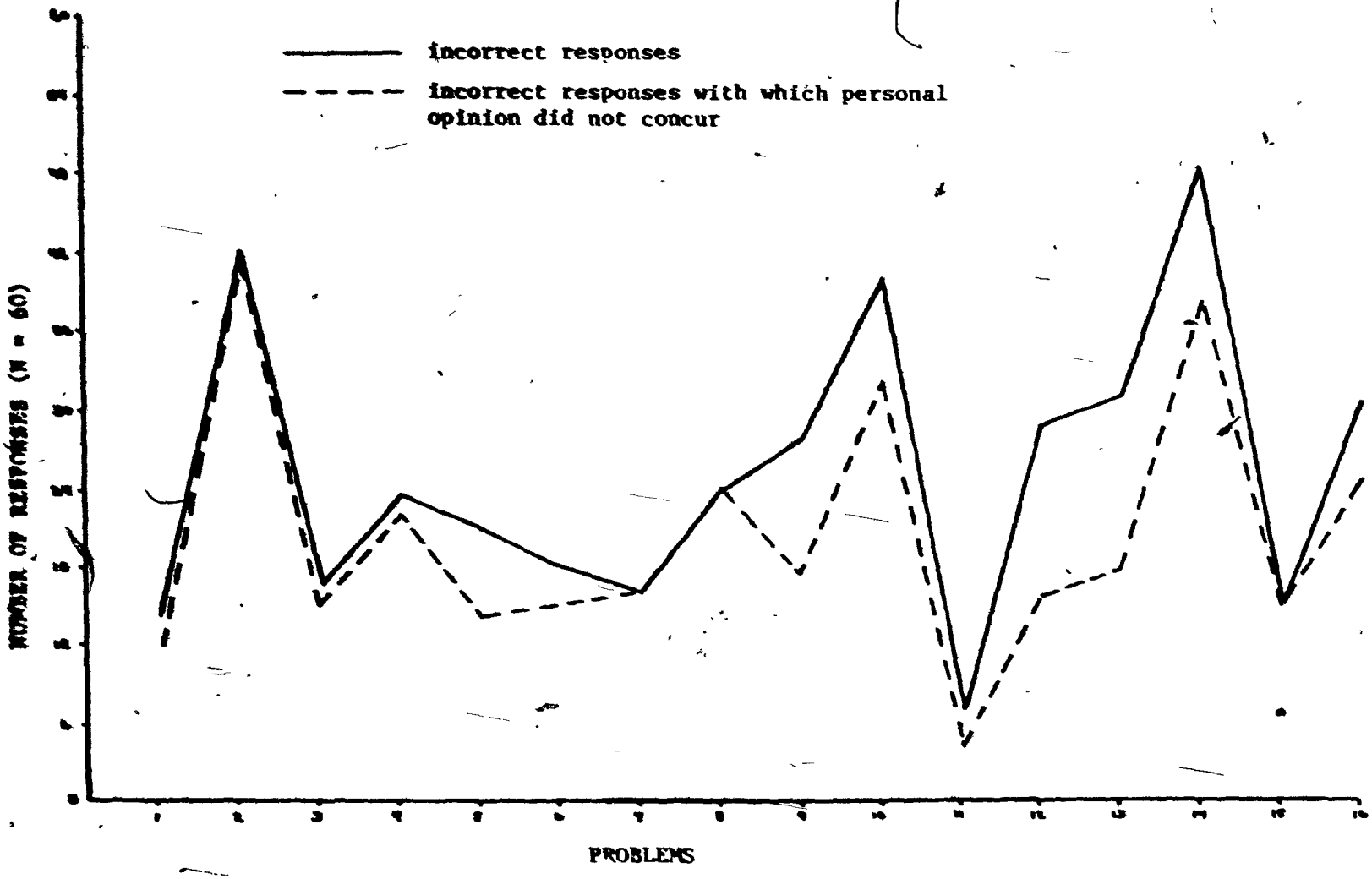

FIGURE 5

THE SYNCHRONY BETWEEN INCORRECT RESPONSES TO THE AFFECTIVE PROBLEMS AND NON-CONCURRENCE OF PERSONAL OPINION WITH THE CONCLUSIONS PRESENTED IN THESE PROBLEMS

blems.

These data may also be viewed from the reverse position of concordance and discordance. From those who agree with the conclusions presented in the problems and therefore share concordant beliefs, we would expect a high percentage of correct judgements on the valid problems; subjects would be inclined to acknowledge readily the validity of a conclusion with which their personal opinion concurs and would hence be led toward correct judgements. In these cases, the influence of affective factors could be said to be beneficial. On the other hand, from those who agree or share the opinions presented in the conclusions of the invalid problems, we would expect a high percentage of incorrect judgements; subjects would be inclined to grant validity to conclusions which their personal biases affirmed despite logical fallacy. These cases would illustrate the detrimental influence of affective factors. These contentions are confirmed by the frequency distributions presented in Table 9. For problems 1 through 16 collectively, concordance with the conclusions presented resulted in 92.1% of the valid problems being answered correctly. Also in keeping with these results, 68.3% of the invalid problems were incorrectly answered, although the discrepancy is not as large here. This trend is represented graphically in Figure 6. This graph illustrates, from all subjects who registered concordance with the conclusions presented in the problems, the relative percentage of correct judgements for problems 1 through 8 and the percentage of erroneous judgements on problems 9 through 16. Although all responses to the valid problems conform to this pattern, two instances of inconsistency on invalid problems 11 and 15 may be noted.

Conversely, from those who disagree with the conclusions presented in the problems and therefore hold discordant beliefs, we would anticipate a

TABLE 9

FREQUENCY DISTRIBUTIONS OF RESPONSES TO THE AFFECTIVE PROBLEMS IN THE SITUATION WHERE PERSONAL OPINION IS CONCORDANT WITH THE CONCLUSIONS PRESENTED IN THESE PROBLEMS

	CORRECT	INCORRECT	
VALID PROBLEMS	175 (92.1%)	15 (7.9%)	190 (43.6%)
INVALID PROBLEMS	78 (31.7%)	168 (68.3%)	246 (56.4%)
	253 (58.0%)	183 (42.0%)	436 (100%)

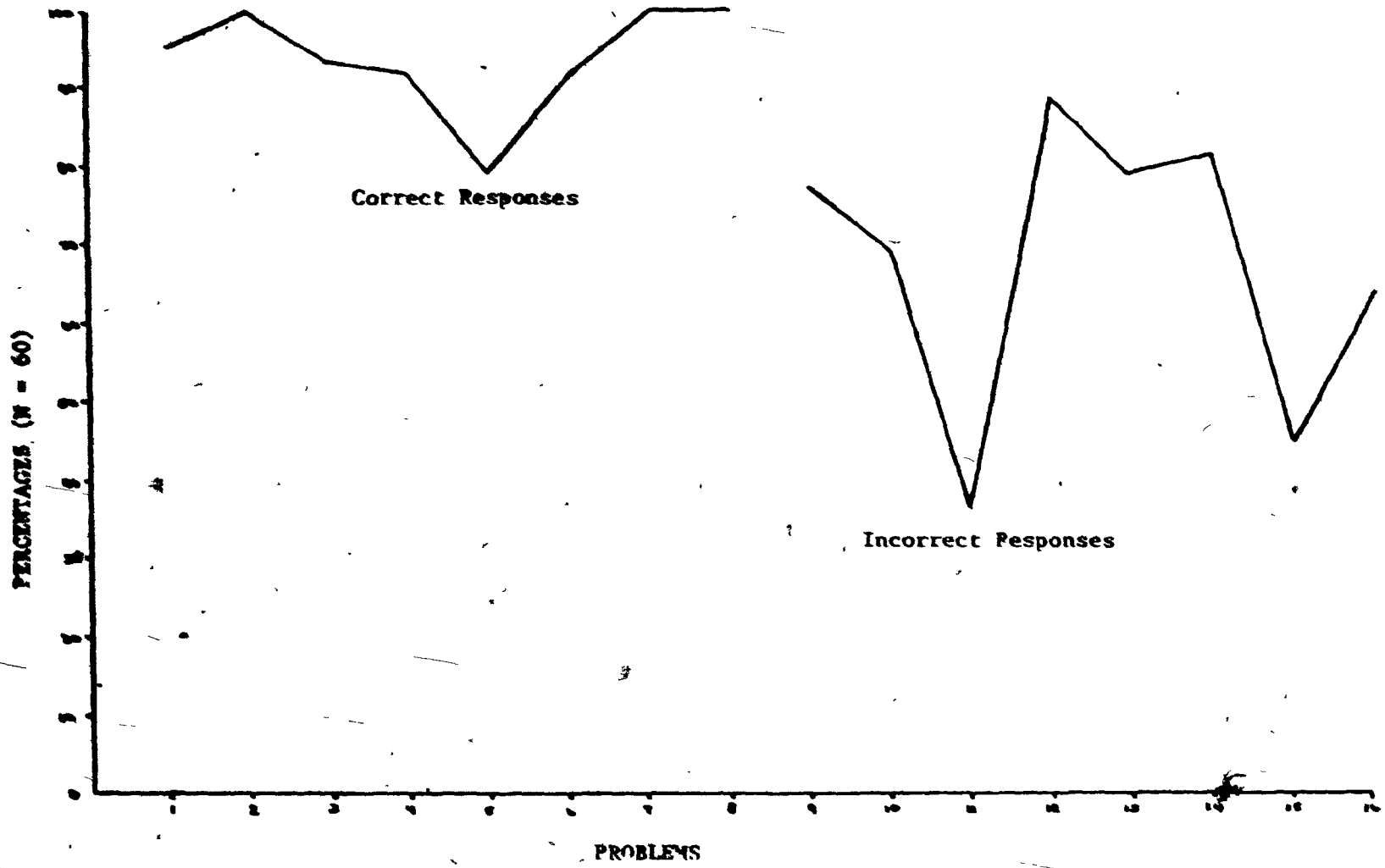

FIGURE 6

THE PERCENTAGE OF RESPONSES TO THE AFFECTIVE PROBLEMS IN THE SITUATION WHERE PERSONAL OPINION WAS CONCORDANT WITH THE CONCLUSIONS PRESENTED IN THESE PROBLEMS

high percentage of incorrect or 'invalid' responses to valid problems 1 through 8; subjects would be inclined to deny validity to a statement with which they do not personally agree despite its logical necessity. Here, subjects would be unfavourably influenced by affective factors. On the other hand, we would expect a high percentage of correct judgements on the invalid problems 9 through 16; subjects would be encouraged in these cases to declare a conclusion invalid if they disagree with it. Subjects in this situation would be beneficially swayed by their affective processes. The data presented in Table 10 substantiate these predictions. As may be seen, for the valid problems 55.2% of the responses were incorrect and for the invalid problems 73.1% of the responses were correct. This overall performance is represented graphically in Figure 7. In all but three instances, problems 4, 10, and 14, these expectations are confirmed.

Therefore, these data suggest that when subjects hold beliefs which are concordant with those presented as concluding statements of reasoning problems, their judgement will be beneficially influenced in the case of valid problems and adversely influenced in the case of invalid problems; whereas when subjects hold beliefs discordant with those presented as concluding statements of problems, an inverse effect is recognized. Table 11 summarizes this overall effect as it is seen on all affective problems collectively. The concordance of personal opinion with the conclusions presented in these problems produced a high instance, 343 out of a possible 436, of correct responses to valid problems and incorrect responses to invalid problems; similarly, discordance shows a high instance, 331 out of 524, of incorrect responses to valid problems and correct responses to invalid problems. These expected frequencies constitute 70.19% of all responses to the affective problems. From these data it may be concluded that, in the

TABLE 10

FREQUENCY DISTRIBUTIONS OF RESPONSES TO THE AFFECTIVE PROBLEMS IN THE SITUATION WHERE PERSONAL OPINION IS DISCORDANT WITH THE CONCLUSIONS PRESENTED IN THESE PROBLEMS

	CORRECT	INCORRECT	
VALID PROBLEMS	130 (44.8%)	160 (55.2%)	290 (55.3%)
INVALID PROBLEMS	171 (73.1%)	63 (26.9%)	234 (44.7%)
	301 (57.4%)	223 (42.6%)	524 (100%)

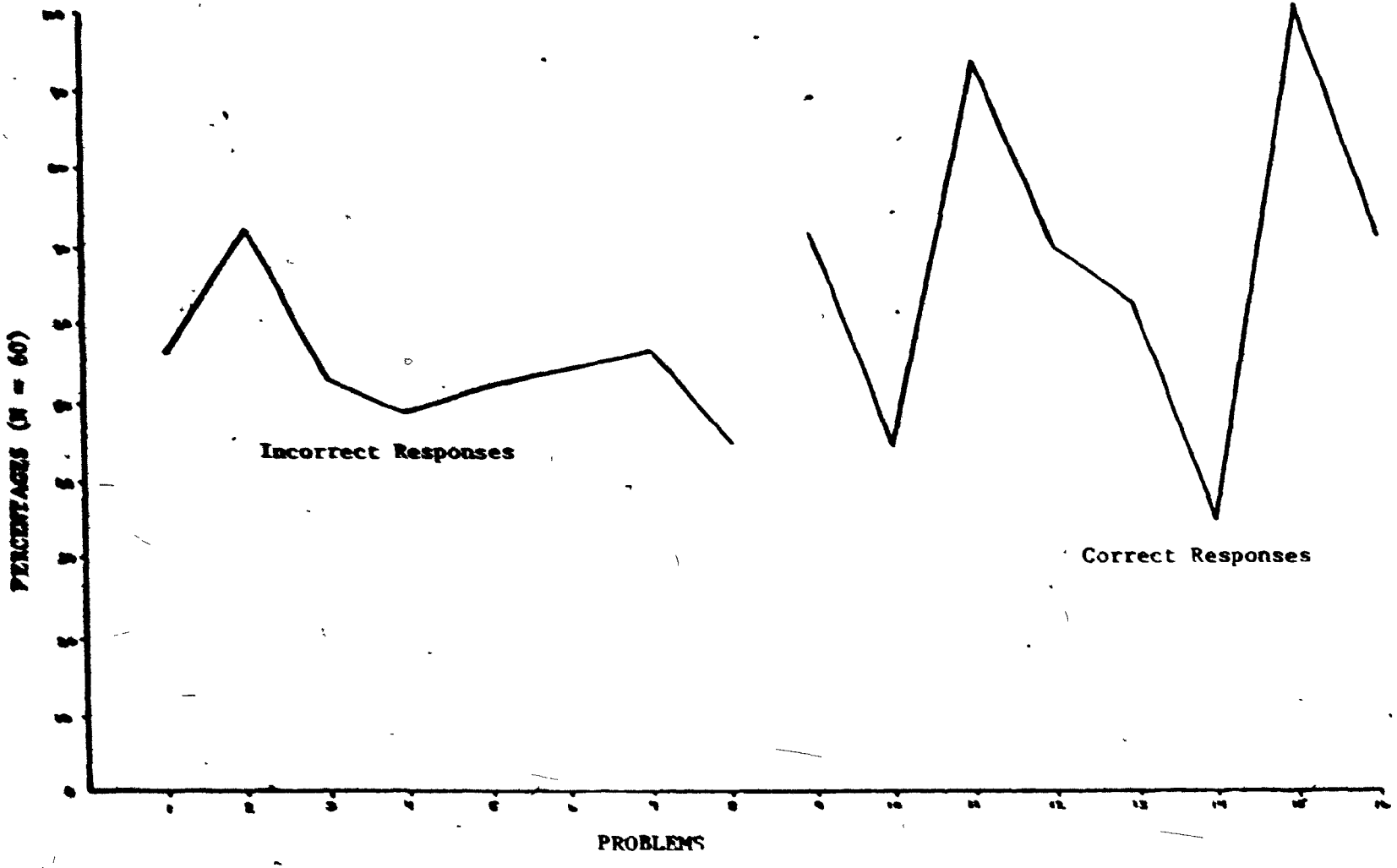

FIGURE 7

THE PERCENTAGE OF RESPONSES TO THE AFFECTIVE PROBLEMS IN THE SITUATION WHERE PERSONAL OPINION WAS DISCORDANT WITH THE CONCLUSIONS PRESENTED IN THESE PROBLEMS

TABLE 11

FREQUENCIES IN THE TOTAL POPULATION FOR ALL AFFECTIVE PROBLEMS FOR VARIOUS COMBINATIONS OF THE VALID-INVALID AND CORRECT-INCORRECT VARIABLES

	VALID-CORRECT INVALID-INCORRECT	VALID-INCORRECT INVALID-CORRECT	
CONCORDANCE	343 (78.67%)	93 (21.33%)	436 (100%)
DISCORDANCE	193 (36.83%)	331 (63.17%)	524 (100%)
	536	424	960

solution of problems evoking emotion, reasoning ability has been influenced significantly either favourably or unfavourably in keeping with personal opinion or affectivity. The feelings and beliefs held by the subjects regarding the conclusions presented in the reasoning problems were a key factor in the successful exercise of formal operational skills.

The foregoing data, therefore, depict graphically the variability in performance between the neutral and affective reasoning problems attributable to the nature of the content of the problems, the validity or invalidity of the problems, and the interaction of these two variables. Further consideration is now given to the factor of age. As was pointed out at the beginning of this chapter, although the factor of age was placed first in a regression model allowing it maximum effect as a source of variance, it did not reach significance. To corroborate this finding, partial correlations were used to hold the variable of age constant and to eliminate its effect on the other two variables being correlated; but, again, no effect was evident. In fact, when the partial correlation coefficients were compared to the original Pearson Product-Moment correlation coefficients, it was found that they did not differ appreciably but, in most instances, were almost identical. Table 12 presents still further corroboration: this table represents the overall percentage of correct performance on all sixteen pairs of problems for each of the three age ranges. As may be seen here, the same discrepancies in performance between the neutral and affective problems exist. The influence of affectivity or personal opinion on reasoning ability does not appear to decrease with age. Even though the difference between the youngest and the oldest age group represents a three year span of development within the formal operational stage, there is no real difference between the means of these two groups. In fact, the percentage of correct

TABLE 12

PERFORMANCE BY AGE: THE PERCENTAGE OF CORRECTLY ANSWERED NEUTRAL AND AFFECTIVE PROBLEMS WITHIN EACH AGE GROUP

	AGE GROUP 1	AGE GROUP 2	AGE GROUP 3*	MEAN
NEUTRAL PROBLEMS	81.3	79.4	80.6	80.4
AFFECTIVE PROBLEMS	59.1	56.9	57.2	57.7
N	20	20	20	TOTAL 60

* AGE 1: 14;6 - 15;5

AGE 2: 15;6 - 16;5

AGE 3: 16;6 - 17+

responses of group 3, the oldest group, is slightly lower than that of group 1, the youngest age group. It seems evident, therefore, that the influence of affective factors on reasoning ability does effect horizontal décalage at the stage of formal operations. However, this décalage does not appear to resolve itself within the age span examined in this study.

A Summary of the Findings

The results and the analyses of the data presented in this and the preceding chapter may be summarized as follows:

1. The percentage of correctly answered neutral problems was significantly greater than the percentage of correctly answered affective problems.
2. The percentage of correctly answered valid problems was greater than the percentage of correctly answered invalid problems.
3. The discrepancy in performance on the neutral and affective problems may be attributable to the factors of content, validity-invalidity, and their interaction. This results in the following range of performance superiority on the four classifications of problems: neutral-valid; neutral-invalid; affective-valid; affective-invalid.
4. Responses to the opinion questionnaire confirm the strong influence of partiality on the part of the subjects in the solution of the affective problems. The concordance of personal opinion with the conclusions presented in these problems produced a high instance of correct responses to valid problems and incorrect responses to invalid problems. Similarly, discordance of personal opinion with the conclusions presented in these problems showed a high instance of incorrect responses to valid problems and correct responses to invalid problems. The influence of affectivity on reasoning ability, therefore, may be said to be either

favourable or unfavourable, depending upon the personal convictions of the reasoners. Affectivity has been shown to be a key factor in the effective use of formal operational skills.

5. Age was not found to be a significant factor in the distortion of reasoning ability produced by affectivity. There was no appreciable difference in the overall performance of students within each of the three designated age groups; in fact, the eldest group, age group 3, was influenced to a minimally greater extent! Therefore, although it is evident that affectivity does determine horizontal décalage at this stage, it does not have a decreasing differential effect within the age span examined in this study.

CHAPTER VI

CONCLUSIONS AND DISCUSSION

Conclusions

It has been the primary purpose of this study to investigate the proposition that adolescent affectivity implies resistance to objectivity and, in so doing, jeopardizes the effective use of formal operational thought. The results of the experiment used in this inquiry and the analyses of the data present evidence which confirms this proposition. The high percentage of correctly answered neutral problems lends credence to the assumption that the subjects participating in this study were capable of exercising formal operational skills effectively when the content of the problems contained nothing to discourage objectivity or to evoke a response based on personal perspective. There was, however, a significant discrepancy between this ability to reason logically when allowed to remain uninvolved with the conclusions presented in the problems and the same ability when influenced by the provocation of affectivity. The substantially lower percentage of correctly answered affective problems shows that the reasoning ability displayed in the former situation was not generalizable to problems identical in logical and technical difficulty which are embodied in content designed to arouse the affectivity of the reasoner. When evaluating the logical validity of problems containing content about which the subjects felt strongly, the adolescents became emotionally involved and allowed an intuitive personal reaction to threaten their objectivity. They were unable, in this situation, to divorce their affective tendencies from the cognitive

demands of the task and to judge only the logical structure of the problems. The arousal of affective factors through the manipulation of content thus blinded the subjects and influenced their ability to reason formally.

The relevance of this discrepancy with regard to the validity and invalidity of the problems is also noteworthy. It is concluded that the influence of affectivity on reasoning ability is evident on both valid and invalid problems, although the discrepancy in performance is more appreciable on valid problems. Indeed, even though the valid problems were more frequently answered correctly, the factor of content, or neutrality-affectivity, appeared to override this variable and resulted in superior performance on both the valid and invalid neutral problems.

A closer analysis of the influence of affectivity on cognitive functioning at this stage shows that this effect may be either favourable or unfavourable in proportion to the concurrence between the conclusions presented in the affective problems and the personal opinions held by the reasoners. From the results of this study we may conclude that the subjects were influenced favourably toward correct judgements when the problems arrived at conclusions which were in sympathy with personal conviction and, on the other hand, were influenced unfavourably when the conclusions presented in the problems were antithetical to their beliefs. This led to a tendency to accept invalid conclusions when they were concordant with strongly held beliefs and to reject valid conclusions when they were discordant with such beliefs; the influence of affectivity acted in harmony with cognitive functioning in the former case, while it distorted logical thought in the latter. In effect, the efficacy with which the affective problems were solved depended greatly on the extent to which the conclusions reached by logic coincided with the beliefs already held by the subjects.

It was the secondary purpose of this study to explore the possibility that affective interference in cognitive functioning is a temporal incongruence determining horizontal décalage at the stage of formal operations. It is evident from the performance discrepancy between the neutral and affective problems that this contention is affirmed and that horizontal décalage does prevail in this instance. However, as the results also indicate, within the framework of the present experiment age was not found to be a significant factor in the influence of affectivity on reasoning ability. As is confirmed by performance on the neutral problems, the subjects within each of the three age groups proved their capacity to execute formal operational thought. However, the inability to generalize this capacity and to resist affective influence when the same task employed emotional content is also displayed by the subjects of each age group. The subjects in age group 3, the eldest group, were equally susceptible to this décalage as the subjects in each of the younger age groups. The tendency of affective interference to jeopardize the efficiency of formal thought has not been found to prevail in inverse proportion to the age of the problem solvers. The influence of affectivity does not appear to decrease with age but continues to obstruct cognitive functioning throughout the stage of formal operations.

Discussion

In light of the theoretical claims of the Piagetian school the implications inherent in the findings of this research are somewhat pessimistic. This study reveals a situation in which the cognitive and affective facets of development reflect an incongruence between their seemingly complementary, indissociable processes. It would appear that, although the affective pro-

causes do motivate or energize cognitive functioning, they may also jeopardize it by denying the objectivity so necessary for the effective use of formal thought.

In the solution of emotionally-toned reasoning problems the adolescents participating in this study failed to alienate themselves from the physical world of their immediate surroundings and to function on a purely hypothetical plane of thought. Although the students were reminded to accept the premises of the problems as fact, despite personal feelings, they nonetheless proved incapable of manipulating these 'assumptions', whose validity was only provisional. In consequence, they based their logical judgement on personal, emotional factors. Their intuitive involvement with the situations presented in these problems made them unable to sacrifice their own beliefs for those of the 'possible' and to sustain momentarily a detachment from the personal point of view, a basic requirement of formal thought. The subjects denied the understanding that conclusions logically derived from the hypothetical have a validity independent of their factual truth. They could not extract the structure of the argument from its content and submit only the form of these problems to logical analysis. Instead, the tendency was to cling to one's own personal perspective and to remain faithful to personal conceptions - a behavioural characteristic typical of the egocentrism which frequently dominates the early stages of development.

Theoretically, this intellectual behaviour is not surprising when one considers the concept of décalage put forward by Piaget in justification of such incongruences. It is undeniably the case that the situation presented in the affective problems was in keeping with the criteria most susceptible to the acknowledged causes of décalage. The specific content of these pro-

blems produced conditions likely to hinder the interaction between the problem solver and his cognitive task. Because it did, by design, encourage a strong reliance on the subjective, the "privileged character" of this content inhibited the subjects and made them unable to generalize the ability displayed in the solution of the neutral problems.

Such a resistance might have been expected with subjects who are still within the 'preparation' phase of development, upon recent transition to the stage of formal operations. The assumption that some subjects might be as yet only making sporadic, tenuous use of these newly acquired skills would cause one to anticipate weakness in ignoring irrelevant emotional background among the youngest age group examined in this study, although even these students were expected to be beyond this initial phase. However, the theoretically inconsistent factor found here is that this affective interference is not only characteristic of the youngest age group but is also applicable to more mature subjects, adolescents who at 16 1/2 and 17 1/2 years of age are believed to be well beyond this unorganized, unstable phase. The fact that these subjects were equally affected by the cognitive-affective conflict revealed here, despite the inevitability of their having attained a "functionally mature" level of 'achievement' within this stage, confirms that the décalage evident in the performance of these adolescents is not a temporal incongruence which is resolved by the property of consolidation or the attainment of the equilibrium characteristic of a mature 'structure d'ensemble'. In essence, the impression gained is that there is a conflict within the developmental processes which may be sustained indefinitely. Should this be so, perhaps the most germane explanation of these findings is provided by the reiteration of a statement cited earlier:

> The attainment of a cognitive stage merely means that an individual under optimim conditions becomes capable of behaving in a certain way which was impossible before.
>
> (Inhelder, 1960, pp. 125-126)

The present study has shown that although the adolescent may be capable of using logical thought effectively he will not necessarily do so at all times or in all situations.

The conclusions arrived at in this research are, for the most part, consistent with the findings of previous studies on related issues. Bart's (1971a) claim that formal operational skills can be meaningfully classified according to their content is undoubtedly corroborated, for it is evident that logical thought was not available uniformly across the two content areas examined in this study. Similarly, the contention expressed by Lovell (1970) and Peel (1960) that formal operational thought is manifested most readily with respect to content with which the thinker is familiar, knowledgeable, and which for him has credibility may be said to have been confirmed by the high instance of correct responses to the neutral problems which did employ content meeting these demands. However, the findings based on performance on the affective problems concur more conclusively with the predictions of Lunzer (1965) who suggests that belief and verisimilitude will often override logical necessity and result in a "dissonance" between the way concepts have been acquired and the way they should be interpreted in the light of novel situations. In keeping with this belief, the suggestions of Bruner, Goodnow and Austin (1956), Wason and Johnson-Laird (1971), Henle (1955; 1962), Thouless (1974) and Peel (1971) that these same factors may prove a "graveyard" of problem solving is a more accurate interpretation of these results. For, while the familiar, highly identifiable content of the affective problems did unquestionably arouse enthusiasm and excitement

for the task, at the same time, its controversial, emotionally-toned nature opened the door for bias and conviction, which the subjects could not easily ignore. Of equal relevance is the question of the significance of interest proposed by Elkind (1961a), Dienes and Jeeves (1965) and Bart (1971b). For again, while on one hand the interest aroused by the content presented in these problems may be said to have elicited an initially beneficial reaction in that it captured and sustained the attention of the subjects, on the other hand, it evoked so much personal involvement that it ultimately acted as an impediment to objectivity and thus denied the effective use of formal thought.

An inconsistency with comparative research may be acknowledged when the present findings are reviewed in relation to those of Donaldson (1963), Case and Collinson (1962) and Peel (1971). The results of the studies on children's thinking conducted by Donaldson (1963) showed that "arbitrary errors" due to the content of problems and the influence of personal experience, decreased with age and that emotional pressure and egocentrism interfered less with cognitive adaptation as the subjects matured. A similar discovery by Case and Collinson (1962) contributes to the optimism of Peel (1971) who voices the belief that age and maturity, through the process of equilibration, resolve the incongruences produced by these factors. Obviously, this has not been the case in the present study. This inconsistency bears further relevance when considered with respect to the socio-economic factor. Peel (1971) cites that the level of adolescent judgement is quite susceptible to cultural and educational influence. He found that a group of boys from markedly superior socio-economic backgrounds made more mature, reasoned judgements than boys from homes at lower socio-economic levels, even though the two groups of subjects were matched for verbal rea-

soning by a customary traditional test. This finding was corroborated by Brydon (1967) who included socio-economic level as one of the variables in his study of the effects upon adolescent judgement of age, sex, I.Q., and the background information provided in the passage. The results of his study showed a significant correlation between socio-economic level and the maturity of judgement. This contention has not been substantiated by the findings of the current study which also used a sample derived from a similarly high socio-economic milieu.

In summary, the evidence produced in this study concurs readily with the conclusions arrived at in many similar studies conducted on adults. In fact, from the findings of Watson (1925), Janis and Frick (1943), Morgan and Morton (1944), Lefford (1946), Thistlethwaite (1950), Feather (1963), and Kaufmann and Goldstein (1967), together with those of the present research, it would seem improbable that there is a 'stage' of human development when the individual does not allow the warm-blooded, emotional side of his nature to rule his rationale. This research confirms the suspicion that the dominance of emotion over reason is not a phenomenon which is peculiar to young children or to adults. The influence of affectivity on adolescent judgement cannot be denied.

CHAPTER VII

A SUPPLEMENTARY EXPERIMENT

Introduction

A stimulus for this supplementary experiment was supplied by observations made in the main experiment concerning the reaction of the students during and upon completion of the testing session. A favourable response to participation in the experiment from the outset made the students most enthusiastic and eager to find "the secret" of this study, to discover what it was "all about"! This initial reaction was, of course, reinforced by the presence of problems dealing with controversial issues pertaining to the school environment. Similarly, the fact that the experiment was conducted by one of their regular class teachers also contributed greatly to a general feeling of bewilderment and curiosity.

Comments such as: "Oh, I know what you're trying to do!"; "But what if it doesn't seem right?"; "The dull ones are much easier, eh?"; "Some are much harder to concentrate on!"; and "Is it ever tricky when you care!" were typical of a variety of verbal reactions to the reasoning test. The following remarks which were written on the test booklets were also noteworthy: "I feel like a real hypocrit!"; "N.B. These are my <u>logical</u> judgements; but they aren't really my opinions!"; "I tried not to let my opinions bother me - but it was hard to concentrate". In addition, students tended on occasion to record their answers in a manner which reflected their partiality. Rather than recording their answers with the expected 'valid' or 'invalid' response, several subjects replied in the following ways: "<u>very</u> valid"; "invalid - for sure!"; or, "Vvvvvvalid"; and so forth. These

reactions confirmed the suspicion that a number of students, whether they gave indication or not, probably did detect the true purpose of the study. This behavioural reaction on the part of these students, many of whom were recognized to be well above average in intelligence, provided the incentive to conduct a follow-up study. It was argued that if the students were warned that the presence of highly emotionally-toned subject matter would make reasoning more difficult, they would be able to guard against this tendency. If this were so, then the differences in performance between the affective and neutral problems would disappear. Therefore, an attempt was made to investigate any discrepancy in performance evident when the subjects are fully aware of the nature of the study.

Experimental Procedure

The same test instruments as were used in the main experiment were administered to a smaller sample of twenty subjects, representing the same three age ranges and chosen according to the same principles of selection from the same overall population. The essential difference in the methodology employed in this experiment concerned the instructions given to this group of subjects. The true nature of the study was fully disclosed to this sample. The subjects were informed that the intent of the experiment was to analyse the influence of emotional interference on adolescent reasoning ability. The two types of problems and the similarities and differences of each, as well as the purpose of the opinion questionnaire which was to follow, were described thoroughly. The students were warned emphatically to be on the alert for problems which contained content about which they might feel strongly and to execute as much discretion as possible in these areas. All aspects of the experiment were questioned and discussed exten-

sively by the subjects before the testing was begun.

The only marked difference in the administration of this session was in the time taken to complete the testing. Whereas most students in the original experiment spent from three-quarters of an hour to an hour working on the test materials, these subjects all completed the assignment within a half to three-quarters of an hour.

Because of the supplementary nature of this experiment, the statistical procedures were limited to obtaining simple descriptive statistics through the use of the 'Codebook' subprogramme of the S.P.S.S. computer package, a factorial analysis of covariance, and joint frequency distributions of responses ('Fastabs') to the two related test materials.

The Results, Analysis of the Data and Interpretation

Table 13 shows the percentage of correctly answered neutral and affective problems. It may be noted here that 73.5% of the neutral problems were answered correctly compared to 61.0% of the affective problems. It is also noteworthy that for both neutral and affective problems the percentage of correctly answered valid problems is appreciably greater than the percentage of correctly answered invalid problems. These results may be viewed graphically in Figure 8. Here, it may be seen that only one pair of problems, item 15, does not concur with these findings. Table 14 shows the corresponding percentage of responses to the opinion questionnaire which concur with the conclusions presented in the affective problems.

The variance in performance on the neutral and affective problems which is produced by the factors of age, validity-invalidity, and content is presented in Table 15. As was the case in the main experiment, a regression model indicates that age was not a significant variable; both validity-

TABLE 13

THE PERCENTAGE OF CORRECTLY ANSWERED NEUTRAL AND AFFECTIVE PROBLEMS (N = 20)

PROBLEMS	VALID								
	1	2	3	4	5	6	7	8	MEANS
NEUTRAL	90	80	85	80	75	85	85	85	83.1
AFFECTIVE	80	70	80	70	60	60	75	65	70.0

PROBLEMS	INVALID									OVERALL MEANS
	9	10	11	12	13	14	15	16	MEANS	
NEUTRAL	55	55	65	65	60	60	70	80	63.8	73.5
AFFECTIVE	50	30	60	60	60	25	85	45	51.9	61.0

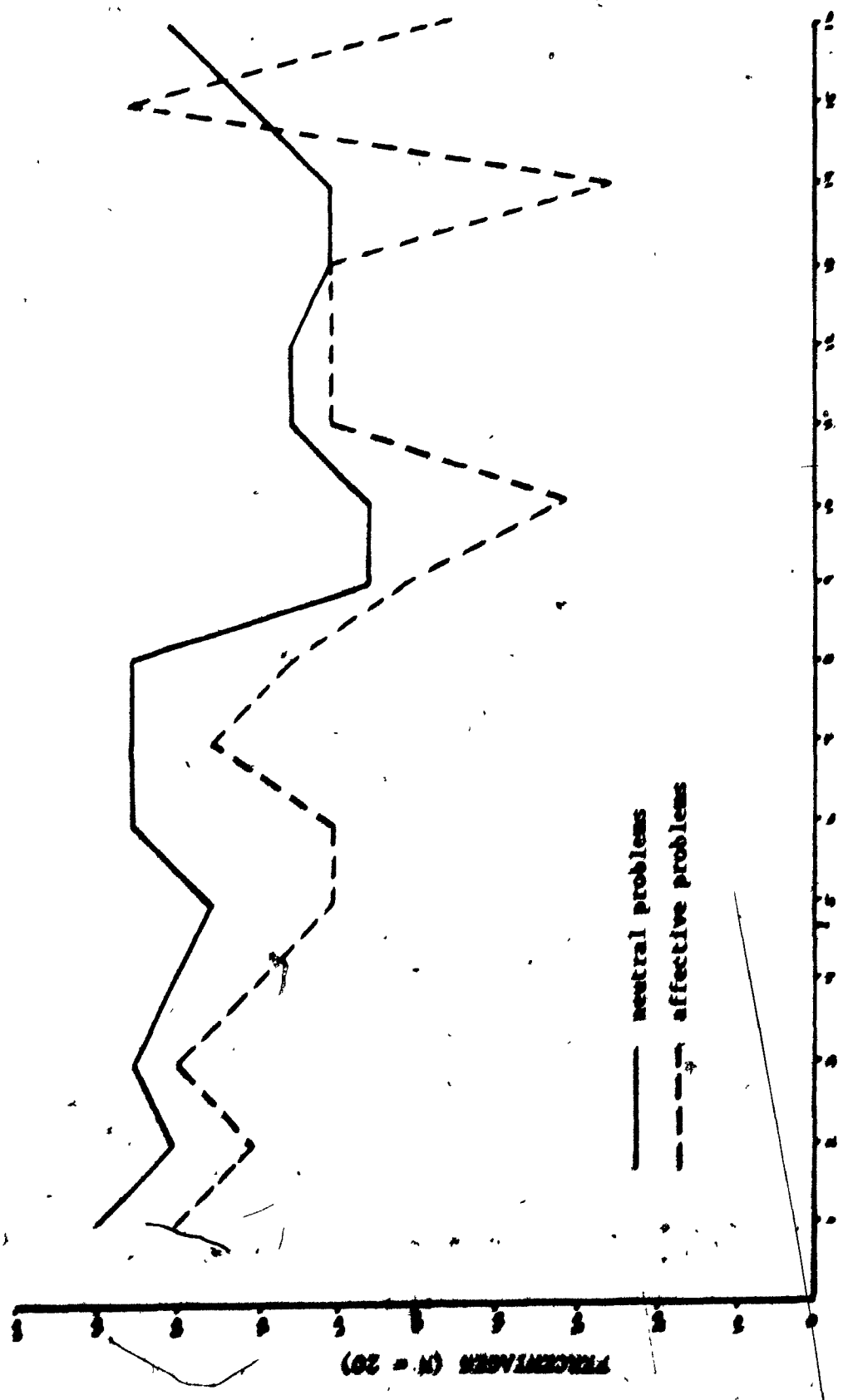

FIGURE 8

THE PERCENTAGE OF CORRECTLY ANSWERED NEUTRAL AND AFFECTIVE PROBLEMS

TABLE 14

OPINION SCALE: THE PERCENTAGE OF RESPONSES TO THE OPINION QUESTIONNAIRE STATEMENTS WHICH CONCUR WITH CONCLUSIONS PRESENTED IN THE AFFECTIVE PROBLEMS
(N = 20)

	STATEMENT NUMBER							
	1	2	3	4	5	6	7	8
PERCENTAGE OF CONCURRENCE	65.0	25.0	55.0	35.0	55.0	40.0	75.0	30.0

	STATEMENT NUMBER							
	9	10	11	12	13	14	15	16
PERCENTAGE OF CONCURRENCE	45.0	0.0	65.0	60.0	75.0	15.0	40.0	30.0

TABLE 13

SUMMARY OF ANALYSIS OF COVARIANCE

SOURCE	d.f.	MEAN SQUARE	F VALUE	PROB > F
AGE	1	0.705	3.386	0.0662
VALIDITY-INVALIDITY	1	5.666	27.211	0.0001
(CONTENT) NEUTRALITY-AFFECTIVITY	1	2.500	12.001	0.0006
INTERACTION OF VALIDITY-INVALIDITY AND CONTENT	1	0.006	0.030	0.8625
ERROR	635	0.208		

invalidity and content were found to be significant; while, unlike the earlier finding, their interaction was denied significance.

A closer analysis of the effects of these significant factors is provided by the 'Fantaha' calculations of frequency distributions. The data presented in Figure 9 depict the extent to which incorrect responses to the affective problems concurred with personal opinion which was discordant with the conclusions presented in these problems. The high instances of these 'invalid'-'negative' responses to items 1 through 8 and 'valid'-'affirmative' responses to items 9 through 16 is clearly confirmed, although again here it is not as consistent on invalid items as on valid items. In keeping with the findings of the main experiment, Figure 10 depicts the influence of personal opinion which is concordant with the conclusions presented in the affective problems. Of the responses which showed concordance, there is a high instance of correctly answered valid problems and a similarly high instance of incorrectly answered invalid problems. Conversely, when the personal opinions held by the subjects were discordant with the conclusions presented in the affective problems, a corresponding trend is noticeable. Figure 11 shows a relatively high percentage of incorrect responses to the valid problems and correct responses to the invalid problems. It is evident from this graph, however, that the influence of personal opinion, or affectivity, does not appear to be nearly as appreciable in this instance. This is perhaps indicative of the fact that the subjects, when warned of these potential effects, were more careful to resist affective interference when they were conscious of their disagreement with the conclusions presented. The data presented in Table 16 summarize this overall effect as it is seen on all affective problems collectively. The concordance of personal opinion with the conclusions presented in these problems produced a high in-

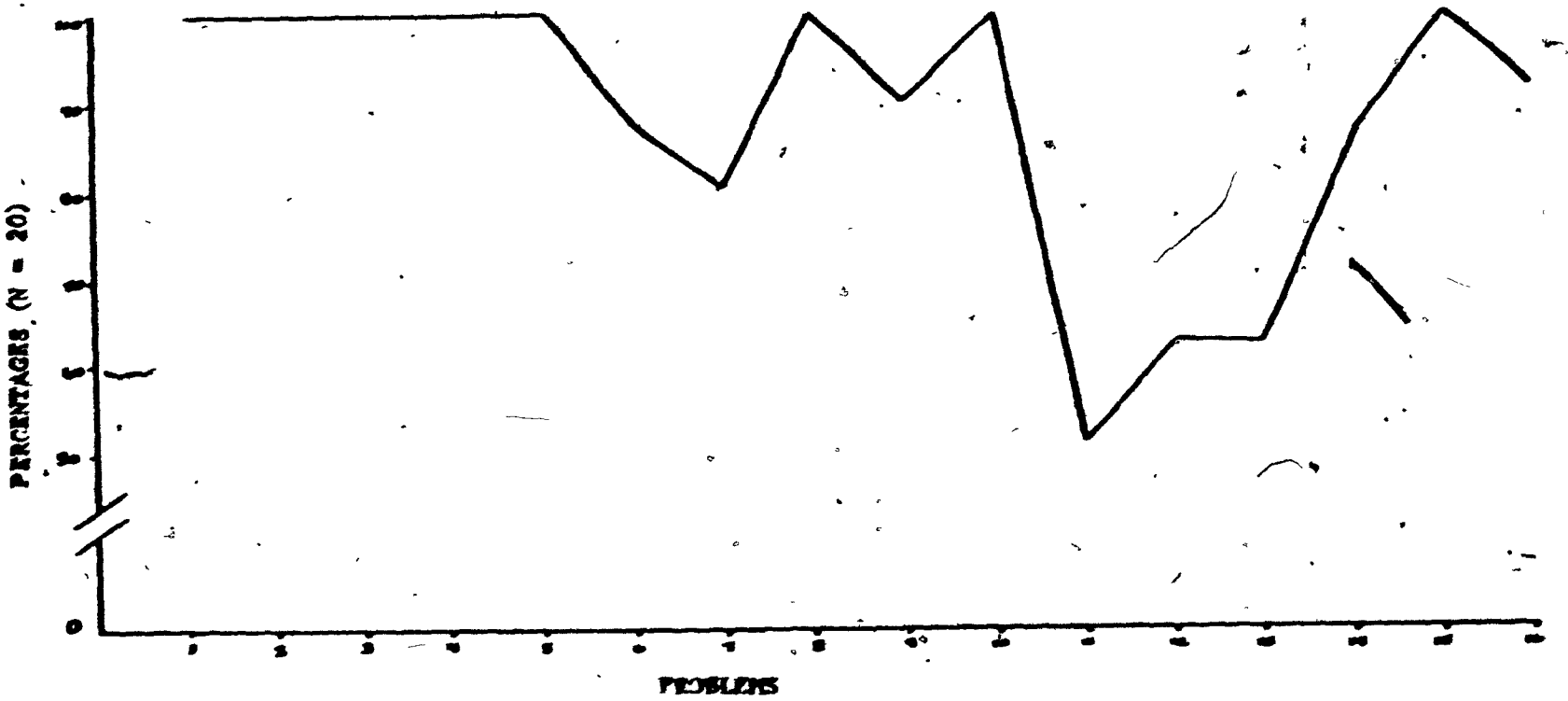

FIGURE 9

THE PERCENTAGE OF INCORRECT RESPONSES TO THE AFFECTIVE PROBLEMS FOR WHICH PERSONAL OPINION WAS DISCORDANT WITH THE CONCLUSIONS PRESENTED IN THESE PROBLEMS

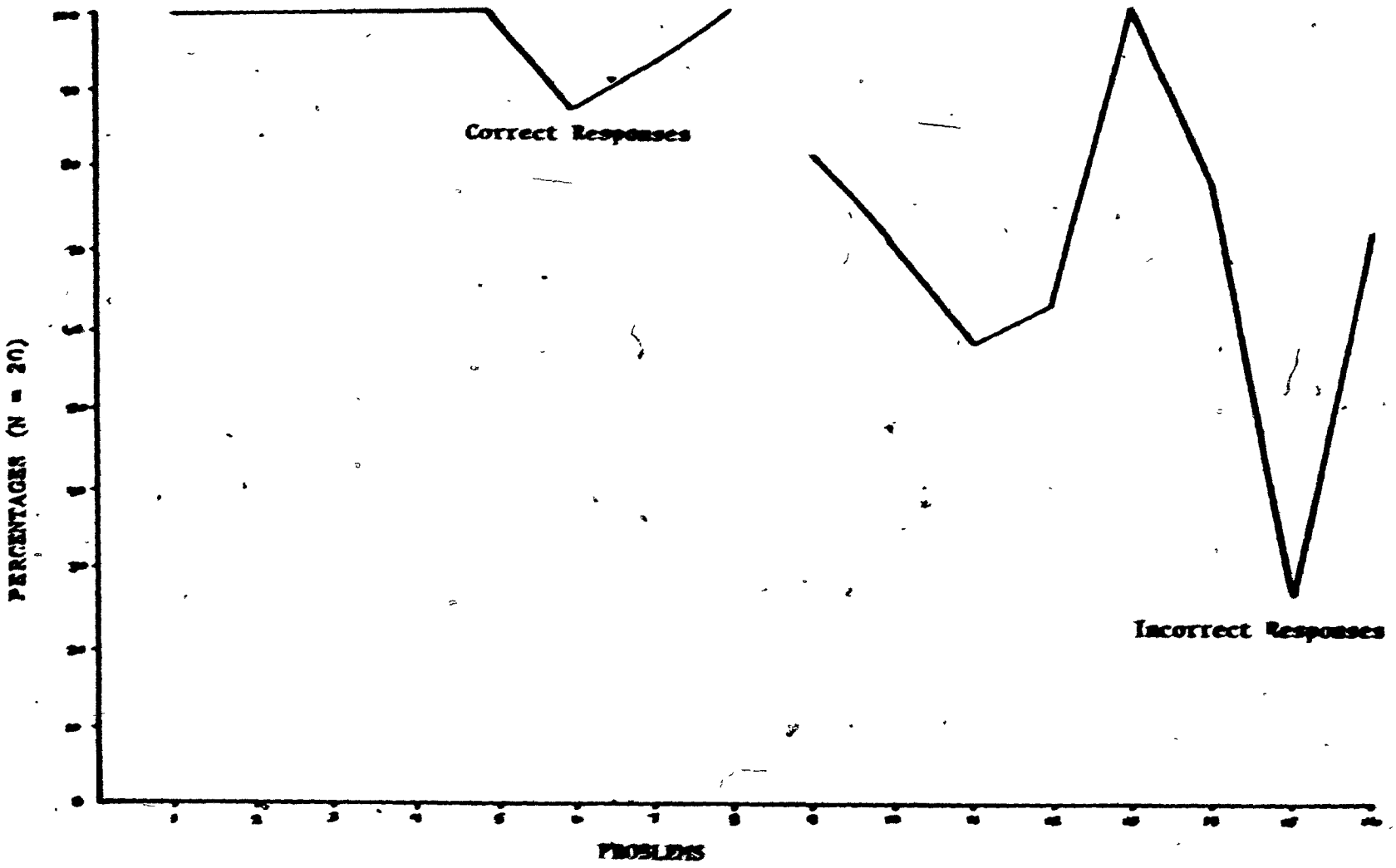

FIGURE 10

THE PERCENTAGE OF RESPONSES TO THE AFFECTIVE PROBLEMS IN THE SITUATION WERE PERSONAL OPINION WAS CONCORDANT WITH THE CONCLUSIONS PRESENTED IN THESE PROBLEMS

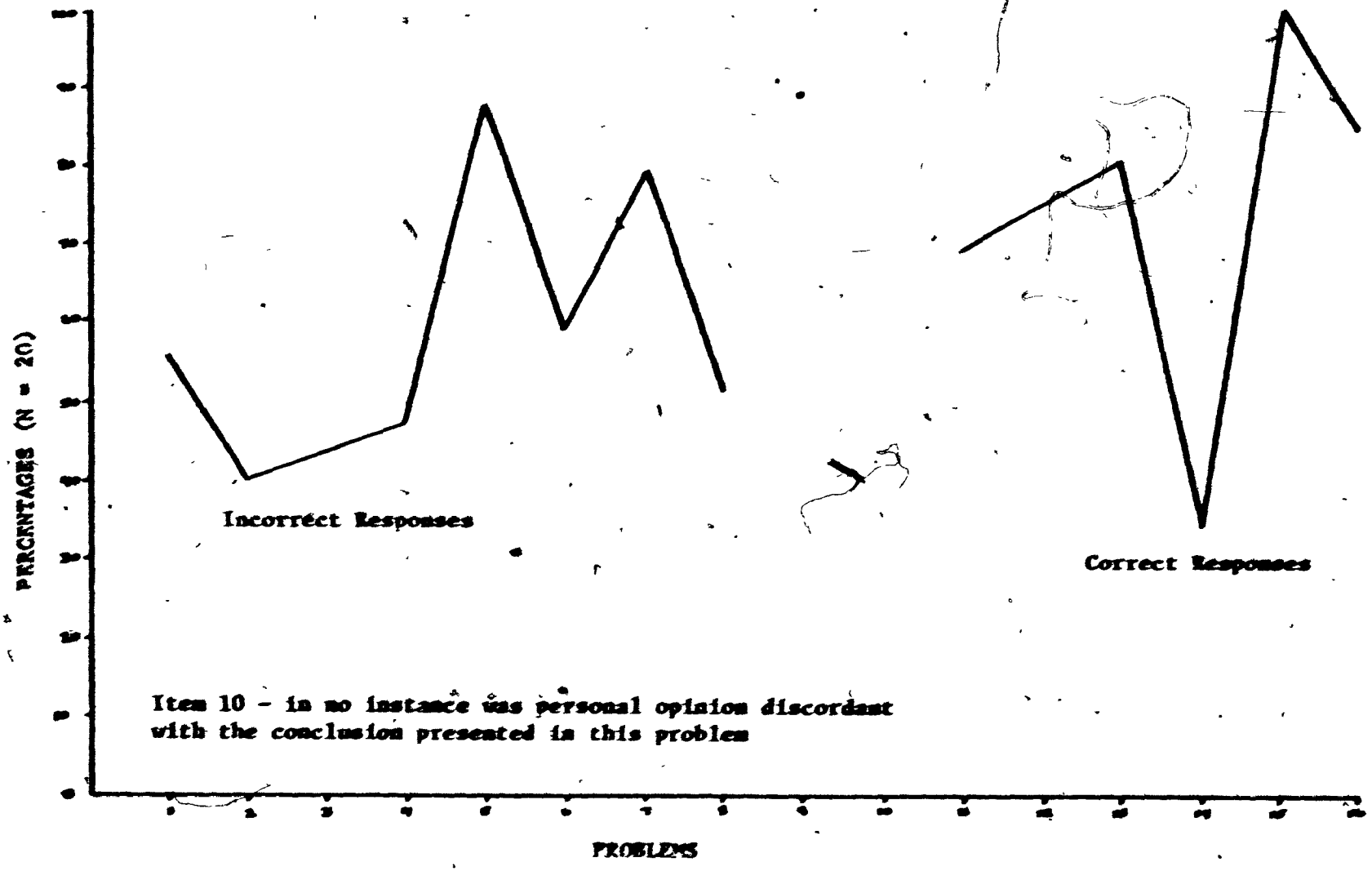

FIGURE 11

THE PERCENTAGE OF RESPONSES TO THE AFFECTIVE PROBLEMS IN THE SITUATION WHERE PERSONAL OPINION WAS DISCORDANT WITH THE CONCLUSIONS PRESENTED IN THESE PROBLEMS

TABLE 16

FREQUENCIES IN THE TOTAL POPULATION FOR ALL AFFECTIVE PROBLEMS FOR VARIOUS COMBINATIONS OF THE VALID-INVALID AND CORRECT-INCORRECT VARIABLES

	VALID-CORRECT INVALID-INCORRECT	VALID-INCORRECT INVALID-CORRECT	
CONCORDANCE	137 (80.59%)	33 (19.41%)	170 (100%)
DISCORDANCE	52 (34.67%)	98 (65.33%)	150 (100%)
	189	131	320

stance, 137 out of a possible 170, of correct responses to valid problems and incorrect responses to invalid problems; likewise, discordance shows a high instance, 98 out of a possible 130, of incorrect responses to valid problems and correct responses to invalid problems. These expected frequencies constitute 73.44% of all responses to the affective problems.

Conclusions

The foregoing results and analyses of the data present evidence which confirms the fact that appreciation of the true purpose of the inquiry did not noticeably reduce the discrepancy in performance between the neutral and affective problems. Although there is some indication that the differences are not quite as great, they are still very substantial and the essential performance distinction remained virtually the same. A full knowledge of the study had no marked effect on the results of the main work; the influence of affectivity is still seen to be a key factor in the successful use of formal operational skills.

BIBLIOGRAPHY

Principal Sources of Reference

Bart, William M. The factor structure of formal operations. British Journal of Educational Psychology, 1971, 41, pp. 70-77. (a)

Bart, William M. The effect of interest on horizontal décalage at the stage of formal operations. Journal of Psychology, 1971, 78, pp. 141-150. (b)

Bruner, J.S., Goodnow, J.J. and Austin, G.A. A Study of Thinking. New York: John Wiley & Sons, 1956.

Donaldson, Margaret. A Study of Children's Thinking. London: Tavistock Publications, 1963.

Elkind, David. Quantity conceptions in junior and senior high school students. Child Development, 1961, 32, pp. 551-560. (a)

Elkind, David. The development of quantitative thinking: a systematic replication of Piaget's studies. Journal of Genetic Psychology, 1961, 98, pp. 37-46. (b)

Elkind, David. Egocentrism in adolescence. Child Development, 1967, 38, pp. 1025-1034.

Elkind, David. Children and Adolescents: Interpretative Essays on Jean Piaget. New York: Oxford University Press, 1970.

Elkind, David and Flavell, John H. (eds.). Studies in Cognitive Development: Essays in Honour of Jean Piaget. New York: Oxford University Press, 1969.

Feather, N.T. Acceptance and rejection of arguments in relation to attitude strength, critical ability, and intolerance of inconsistency. Journal of Abnormal and Social Psychology, 1964, 69, pp. 127-136.

Flavell, John H. The Developmental Psychology of Jean Piaget. New York: Van Nostrand Reinhold, 1963.

Flavell, John H. and Wohlwill, Joachim F. Formal and functional aspects of cognitive development. In Elkind, David and Flavell, John H. (eds.), Studies in Cognitive Development: Essays in Honour of Jean Piaget. New York: Oxford University Press, 1969, pp. 67-120.

Green, Donald R., Ford, Marguerite P., and Flamer, George B. (eds.). Measurement and Piaget. New York: McGraw-Hill, 1971.

Henle, Mary. Some effects of motivational processes on cognition. Psychological Review, 1955, 62, pp. 423-432.

Inhelder, Barbel. Third discussion: The definition of stages of development. In Tanner, J.M. and Inhelder, Barbel (eds.), Discussions on Child Development. Vol. 1-4. New York: International Universities Press, 1960, Vol. 4, pp. 116-135.

Inhelder, Barbel and Piaget, Jean. The Growth of Logical Thinking from Childhood to Adolescence. New York: Basic Books, 1958.

Janis, Irving L. and Frick, Frederick. The relationship between attitudes toward conclusions and errors in judging logical validity of syllogisms. Journal of Experimental Psychology, 1943, 33, pp. 73-77.

Kaufmann, Harry and Goldstein, Stephen. The effects of emotional value of conclusions upon distortion in syllogistic reasoning. Psychonomic Science, 1967, 7, pp. 367-368.

Lefford, Arthur. The influence of emotional subject matter on logical reasoning. Journal of General Psychology, 1946, 34, pp. 127-151.

Lovell, Kenneth. Some problems associated with formal thought and its assessment. In Green, Donald R. et al. (eds.), Measurement and Piaget. New York: McGraw-Hill, 1971, pp. 81-102.

Lunzer, E.A. Formal reasoning. In Lunzer, E.A. and Morris, E.F. (eds.), Development in Human Learning. London: Staples Press, 1968, pp. 266-303.

Lunzer, E.A. and Morris, E.F. (eds.). Development in Human Learning. London: Staples Press, 1968.

Mischel, Theodore (ed.). Cognitive Development and Epistemology. New York: Academic Press, 1971.

Morgan, John J.B. and Morton, James T. The distortion of syllogistic reasoning produced by personal conviction. Journal of Social Psychology, 1944, 20, pp. 39-59.

Nie, Norman H., Bent, Dale H. and Hull, C. Hadlai. Statistical Package for the Social Sciences. New York: McGraw-Hill, 1970.

Peel, E.A. The Pupil's Thinking. London: Oldbourne Press, 1960.

Peel, E.A. A study of differences in the judgments of adolescent pupils. British Journal of Educational Psychology, 1966, 36, pp. 77-86.

Peel, E.A. Conceptual learning and explainer thinking. In Lunzer, E.A. and Morris, E.F. (eds.), Development in Human Learning. London: Staples Press, 1968, pp. 304-329.

Peel, E.A. The Nature of Adolescent Judgment. New York: Wiley Interscience, 1971.

Piaget, Jean. Le mécanisme du développement mental et les lois du groupement des opérations. Arch. Psychol., Genève, 1941, 28, pp. 215-285. (Cited by Pinard and Laurendeau, 1969)

Piaget, Jean. The Psychology of Intelligence. London: Routledge and Kegan Paul, 1950.

Piaget, Jean. Les relations entre l'affectivité et l'intelligence dans le développement mental de l'enfant. Paris: Centre de Documentation Univ., 1954. (Cited by Mischel, 1971)

Piaget, Jean. Third discussion: The definition of stages of development. In Tanner, J.M. and Inhelder, Barbel (eds.), Discussions on Child Development. Vol. 1-4. New York: International Universities Press, 1960, Vol. 4, pp. 116-135.

Piaget, Jean. Six Psychological Studies. New York: Vintage Books, 1967.

Piaget, Jean. Judgment and Reasoning in the Child. New Jersey: Littlefield, Adams, 1969.

Piaget, Jean. The theory of stages in cognitive development. In Green, Donald R. et al. (eds.), Measurement and Piaget. New York: McGraw-Hill, 1971, pp. 1-11.

Pinard, Adrien and Laurendeau, Monique. Stage in Piaget's cognitive-developmental theory: exegesis of a concept. In Elkind, David and Flavell, John H. (eds.), Studies in Cognitive Development: Essays in Honour of Jean Piaget. New York: Oxford University Press, 1969, pp. 121-170.

Service, Jolayne. A User's Guide to the Statistical Analysis System. North Carolina: Student Supply Stores, North Carolina State University, 1972.

Stone, M.A. The development of interstitutional generality of formal thought. Unpublished Doctoral Dissertation, University of Illinois, 1966. (Cited by Bart, 1971a)

Tanner, J.M. and Inhelder, Barbel (eds.). Discussions on Child Development. Vol. 1-4. New York: International Universities Press, 1960.

Thistlethwaite, D. Attitude and structure as factors in the distortion of reasoning. Journal of Abnormal Psychology, 1950, 45, pp. 442-458.

Thouless, Robert H. Effect of prejudice on reasoning. British Journal of Psychology, 1959, 50, pp. 289-293.

Thouless, Robert H. Straight and Crooked Thinking. London: Pan Books, 1974. (17th printing)

Wason, P.C. and Johnson-Laird, P.N. Psychology of Reasoning: Structure and Content. Cambridge: Harvard University Press, 1972.

Supplementary Sources of Reference

Abercrombie, M.J.I. The Anatomy of Judgment. London: Hutchinson, 1960.

Baldwin, Alfred L. Theories of Child Development. New York: John Wiley & Sons, 1968.

Berlyne, D.E. Recent developments in Piaget's work. British Journal of Educational Psychology, 1957, 27, pp. 1-12.

Boat, O.G. The development of explanatory thought in the adolescent in out-of-school situations. Dip. Child Psych. research, School of Education, Birmingham University, 1967. (Cited by Peel, 1971)

Braine, M.S. Piaget on reasoning. In Mussen, P.H. (ed.), European Research in Cognitive Development. Monographs of the Society for Research in Child Development, 1962, 27, pp. 41-63.

Bruner, J.S. Inhelder and Piaget's, The Growth of Logical Thinking. I. A psychologist's viewpoint. British Journal of Psychology, 1959, 50, pp. 363-370.

Brydon, J. An investigation of certain factors entering into the judgments of adolescent boys and girls. Dip. Child Psych. research, School of Education, Birmingham University, 1967. (Cited by Peel, 1971)

Bulwer, J.S. The effect of unfamiliar settings on the solution of problems. Unpublished D.C.P. dissertation, 1957. (Cited by Peel, 1960)

Case, D. and Collinson, J.M. The development of formal thinking in verbal comprehension. British Journal of Educational Psychology, 1962, 32, pp. 103-111.

Cochrane, R. and Duffy, S. Psychology and scientific method. Bulletin of the British Psychological Society, 1974, 27, pp. 117-121.

Cowan, P.A. Cognitive egocentrism and social interaction. (Abstract) American Psychologist, 1966, 21, p. 623.

Davies, G.R. Concrete and formal thinking among adolescent children of average ability. Unpublished M.Ed. thesis, Birmingham University, 1964. (Cited by Peel, 1971)

Dienes, Z.P. and Jeeves, M.A. Thinking in Structures. Psychological Monographs on Cognitive Processes, Vol. 1. London: Hutchinson Educational, 1965.

Dockrell, W.B. (ed.). On Intelligence, Contemporary Theories and Educational Implications: A Symposium, Toronto, 1969. Toronto: The Ontario Institute for Studies in Education, 1970.

Elkind, David. Children's discovery of the conservation of mass, weight, and volume: Piaget replication study II. Journal of Genetic Psychology, 1961, 98, pp. 219-227. (c)

Elkind, David. Cognitive structure and adolescent experience. Adolescence, 1968, 2, pp. 427-434.

Eysenck, H.J. Who needs a random sample? Bulletin of the British Psychological Society, 1975, 28, pp. 195-198.

Festinger, Leon. The motivating effect of cognitive dissonance. In Harper, Robert J.C. et al. (eds.), The Cognitive Processes: Readings. New Jersey: Prentice-Hall, 1964, pp. 509-523.

Flavell, John H. An analysis of cognitive developmental sequences. Institute of Child Development: University of Minnesota, 1971.

Gagné, Robert. Contributions of learning to human development. Psychological Review, 1968, 75, pp. 177-191.

Goldschmid, M.L. Different types of conservation and nonconservation and their relation to age, sex, I.Q., M.A. and vocabulary. Child Development, 1967, 38, pp. 1229-1246.

Goodnow, Jacqueline J. A test of milieu effects with some of Piaget's tasks. Psychological Monographs, 1962, 76, No. 36. (Whole number 555)

Goodnow, J.J. and Bethon, G. Piaget's tasks: the effects of schooling and intelligence. Child Development, 1966, 37, pp. 573-582.

Gourevitch, Vivian and Feffer, M.H. A study of motivational development. Journal of Genetic Psychology, 1962, 100, pp. 361-375.

Hallam, R.N. Logical thinking in history. Educational Review, 1967, 19, pp. 183-202.

Harper, Robert J.C., Anderson, Charles C., Christensen, Clifford M., and Hunka, Steven M. (eds.). The Cognitive Processes: Readings. New Jersey: Prentice-Hall, 1964.

Henle, Mary. On the relation between logic and thinking. Psychological Review, 1962, 69, pp. 366-378.

Henle, Mary and Michael, Miriam. The influence of attitudes on syllogistic reasoning. Journal of Social Psychology, 1956, 44, pp. 115-127.

Hilton, M. Unpublished work on the effect of increased information on solving judgment problems. University of Birmingham, 1968. (Cited by Peel, 1971)

Hooper, F.H. Piaget's conservation tasks: the logical and developmental priority of identity conservation. Journal of Experimental Child Psychology, 1969, 8, pp. 234-240.

Hovland, C.I. and Rosenberg, M.J. (eds.). Attitude Organisation and Change. New Haven: Yale University Press, 1960.

Hughes, M.M. A four-year longitudinal study of the growth of logical thinking in a group of secondary modern schooling. Unpublished M.Ed. thesis, University of Leeds, 1965. (Cited by Lovell, 1971)

Inhelder, Barbel and Piaget, Jean. The Early Growth of Logic in the Child. London: Routledge and Kegan Paul, 1964.

Inhelder, Barbel and Sinclair, H. Learning cognitive structures. In Mussen, P.H. et al. (eds.), Trends and Issues in Developmental Psychology. New York: Holt, Rinehart & Winston, 1969, pp. 2-21.

Inhelder, Barbel, Sinclair, Hermine and Bovet, Magali. Learning and the Development of Cognition. Cambridge: Harvard University Press, 1974.

Jackson, S. The growth of logical thinking in normal and subnormal children. (Abstract) British Journal of Educational Psychology, 1965, 35, pp. 255-258.

Jeeves, M.A. Perception and thinking in animals and men - an experimental study. Unpublished Ph.D. thesis, Cambridge Library, 1957. (Cited by Dienes and Jeeves, 1965)

Johnstone, Henry W. Elementary Deductive Logic. New York: Thomas Y. Crowell Co., 1964.

Kimball, R.L. A background concept study in Malawi. Domasi: Science Centre, 1968. (Cited by Lovell, 1971)

Lodwick, A.R. Whether the inference that children draw in learning history correspond to the stages of mental development that Piaget postulates. Unpublished dissertation, Dip. Ed., Birmingham University, 1958. (Cited by Peel, 1971)

Lovell, Kenneth. A follow-up study of Inhelder and Piaget's The Growth of Logical Thinking. British Journal of Psychology, 1961, 52, pp. 143-153.

Lovell, K. and Butterworth, I.B. Abilities underlying the understanding of proportionality. Mathematics Teaching, 1966, 37, pp. 5-9.

Lovell, K., Mitchell, B. and Everett, I.R. An experimental study of the growth of some logical structures. British Journal of Psychology, 1962, 53, pp. 175-188.

Lovell, K. and Shields, J.B. Some aspects of a study of the gifted child. British Journal of Educational Psychology, 1967, 37, pp. 201-208.

Lunzer, E.A. Some points of Piagetian theory in the light of experimental criticism. Journal of Child Psychology and Psychiatry, 1960, 1, pp. 191-202.

Lunzer, E.A. Problems of formal reasoning in test situations. In Mussen, P.H. (ed.), European Research in Cognitive Development. Monographs of the Society for Research in Child Development, 1965, 30, pp. 19-46.

McGuire, W.J. A syllogistic analysis of cognitive relationships. In Hovland, C.I. and Rosenberg, M.J. (eds.), Attitude Organization and Change. New Haven: Yale University Press, 1960, pp. 65-111.

McLaughlin, G. Harry. Psycho-logic: a possible alternative to Piaget's Formulation. British Journal of Educational Psychology, 1963, 33, pp. 61-67.

Moynahan, E. Performance inconstancies and décalages among conservation tasks. Institute of Child Development: University of Minnesota, 1970.

Mussen, P.H., Langer, J. and Covington, M. (eds.). Trends and Issues in Developmental Psychology. New York: Holt, Rinehart & Winston, 1969.

Mussen, P.H. (ed.). Carmichael's Manual of Child Psychology, Vol. 1. New York: John Wiley & Sons, 1970.

Muuss, R.E. Jean Piaget's cognitive theory of adolescent development. Adolescence, 1967, 2, pp. 285-310.

Nassefat, M. Etude quantitative sur l'évolution des opérations intellectuelles. Neuchâtel: Delachaux et Niestlé, 1963. (Cited by Flavell and Wohlwill, 1969)

O'Brien, T.C. and Shapiro, B.J. The development of logical thinking in children. American Educational Research Journal, 1968, 5, pp. 531-542.

Parsons, C. Review of B. Inhelder and J. Piaget, The Growth of Logical Thinking from Childhood to Adolescence: an essay on the construction of formal operational structures. British Journal of Psychology, 1960, 51, pp. 75-84.

Peel, E.A. Experimental examination of some of Piaget's schemata. British Journal of Educational Psychology, 1959, 29, pp. 89-103.

Peel, E.A. Intellectual growth during adolescence. Educational Review, 1965, 17, pp. 169-180.

Peluffo, N. Cultural and cognitive problems. International Journal of Psychology, 1967, 2, pp. 187-198.

Piaget, Jean. Play, Dreams and Imitation in Childhood. New York: Norton, 1951.

Piaget, Jean. Logic and Psychology. Manchester: University Press, 1953.

Piaget, Jean. Piaget's theory. In Mussen, P.H. (ed.), Carmichael's Manual of Child Psychology, Vol. 1. New York: John Wiley & Sons, 1970, pp. 703-732.

Piaget, Jean. The Child and Reality. New York: Grossman Publishers, 1973.

Piaget, Jean and Inhelder, Barbel. Le développement des quantités chez l'enfant. Paris: Delachaux et Niestlé, 1940. (Cited by Elkind, 1961c)

Piaget, Jean and Inhelder, Barbel. The Psychology of the Child. New York: Basic Books, 1969.

Popper, K. Objective Knowledge. Oxford: Clarendon Press, 1972.

Rhys, W.T. The development of logical thought in the adolescent with reference to the teaching of geography in the secondary school. Unpublished M.Ed. research, Birmingham University, 1964. (Cited by Peel, 1971)

Stones, S.K. An analysis of the growth of adolescent thinking in relation to their comprehension of school history material. Dip. Child Psych. research. School of Education, Birmingham University, 1965. (Cited by Peel, 1971)

Stones, S.K. Factors influencing the capacity of adolescents to think in abstract terms in the understanding of history. M.Ed. research, Manchester University, 1967. (Cited by Peel, 1971)

Thorndike, Edward L. The effect of changed data upon reasoning. Journal of Experimental Psychology, 1922, pp. 33-38.

Tuddenham, Read D. A 'Piagetian' test of cognitive development. In Dockrell, W.B. (ed.), On Intelligence. Contemporary Theories and Educational Implications: A Symposium. Toronto, 1969. Toronto: The Ontario Institute for Studies in Education, 1970, pp. 49-70.

Uzgiris, I.C. Situational generality of conservation. Child Development, 1964, 35, pp. 831-841.

Watson, G.B. The Measurement of Fairmindedness. New York: Teachers College, Columbia University, 1925.

Wilkins, M.C. The effect of changed material on ability to do formal syllogistic reasoning. Archives of Psychology, 1928, 102, pp. 1-79.

Woodworth, R.S. and Sells, S.B. An atmosphere effect in formal syllogistic reasoning. Journal of Experimental Psychology, 1935, 18, pp. 451-460.

Yudin, L.W. Formal thought in adolescence as a function of intelligence. Child Development, 1966, 37, pp. 697-708.

APPENDIX A

THE MEASURING INSTRUMENTS

Included in this appendix are:

The Reasoning Test

The Opinion Questionnaire

The Reasoning Test

The reasoning test items have been arranged here in pairs with the neutral and corresponding affective problems labelled A and B respectively. These are followed by the extraneous problems.

1. A. Nations of the world must strive to encourage and promote patriotism. The singing of national anthems encourages and promotes patriotism. Therefore, nations of the world must continue the singing of their national anthems.

   B. Private schools must strive to uphold their heritages and traditions. The wearing of a school uniform has been a tradition of the E.C.S. since the founding of the school. Therefore, E.C.S. must continue to enforce the wearing of a school uniform.

2. A. Many doctors have shown that people suffering from severe allergies live more comfortably in rural areas, away from pollution, than in large cities. Dunrobin is a rural area with very little pollution. Therefore, people suffering from severe allergies live more comfortably in Dunrobin than in New York.

   B. It has been proposed by many educational psychologists that teenagers learn more effectively in a co-educational environment. West Hill High School provides a co-educational environment. Therefore, the teenagers at West Hill High School learn more effectively than the teenagers at E.C.S.

3. A. Farm lands which receive a great deal of sunlight must be irrigated to insure sufficient moisture. San Andreas, California is a farming area which receives a great deal of sunlight. The farm lands of San Andreas, therefore, must be irrigated to insure sufficient moisture.

   B. Students who assume added responsibilities within the school should be granted special privileges in return for their services. The school Prefects assume added responsibilities at E.C.S. The school Prefects, therefore, should be granted special privileges.

4. A. Garage maintenance which fosters the efficient functioning of automobiles safe-guards against unnecessary accidents. Spark plug tune-ups and brake alignments foster the efficient functioning of automobiles. Therefore, spark plug tune-ups and brake alignments safe-guard against unnecessary accidents.

   B. School practices which develop the moral and social well-being of the students should be encouraged at all times. Morning prayers and hymn singing undoubtedly contribute to the moral and social well-being of the students. Therefore, morning assembly should include prayers and hymn singing.

5. A. Any abnormal weather condition is undesirable and hazardous for farm crops. Freezing June temperatures are not a normal weather condition. Therefore, freezing June temperatures are not desirable or safe for farm crops.

   B. Any behaviour contrary to the school rules is definitely harmful and undesirable for the welfare of our school. The wearing of jeans on school grounds is not in agreement with the school rules. Therefore, the wearing of jeans on school grounds is not good or desirable for the welfare of E.C.S.

6. A. A fire must have oxygen in order to burn freely. Suffocating a fire with a blanket prohibits the flames from getting oxygen. Therefore, suffocating a fire with a blanket will not allow it to burn freely.

   B. Teenagers should be given freedom to exercise their own free will and self-discipline. Compelling students to attend all classes prohibits the exercise of their free will and self-discipline. Therefore, attendance at all classes should not be compulsory for teenagers.

7. A. Each April the working public must file income tax returns with the federal government. Businessmen are members of the working public. Therefore, businessmen must file income tax returns with the federal government each April.

   B. Each spring the school body must elect the school Prefects for the coming year. The members of the teaching staff are part of the school body. Therefore, the members of the teaching staff must have a vote in the election of the school Prefects.

8. A. Factory managers must not allow anything to slow down or hinder the regular flow of production. Run-down, faulty machinery slows down and hinders the regular flow of production. Therefore, factory managers must not allow run-down, faulty machinery to exist.

   B. Weak students must not be allowed to let anything interfere with or disrupt their academic development. Participation in extra-curricular activities interferes with and disrupts academic development. Therefore, weak students must not be allowed to participate in extra-curricular activities.

9. A. The people of Hunga in Kashmir are known to achieve longevity, to live to a great old age. Also, the people of Hunga in Kashmir are particularly healthy people. Therefore, sound evidence of good health is longevity, living to a great old age.

   B. Miss X has attained repeatedly high marks throughout her school career at E.C.S. Also, Miss X is a particularly intelligent girl. Therefore, the attainment of repeatedly high marks in school is valid indication of an intelligent girl.

10. A. When the material with which a ship is built is lighter than water, then the ship will float. The ship "S.S. America" has been successfully launched and has remained afloat. We may therefore conclude that the "S.S. America" has been built of materials which are lighter than water.

    B. When the teachers in a school are well trained and dedicated to their profession, then the students will be successful. The students graduating from R.C.S. do especially well on their Matriculation examinations. We may therefore conclude that the students of R.C.S. are taught by well trained, dedicated teachers.

11. A. The presence of a bright red sky in the evening predicts fair weather for the following day. Unfortunately, the sky this evening is quite grey. Therefore, tomorrow's weather will be cloudy.

    B. Consistent hard work on homework assignments will produce good results on final June examinations. Some students avoid consistent hard work on their homework assignments. Therefore, these students will fail their final June examinations.

12. A. Health experts claim that Niacin is a valuable dietary supplement for children who are suffering from malnutrition. Physically active children with bright, rosy cheeks are not suffering from malnutrition. Therefore, Niacin is not a valuable dietary supplement for physically active children with bright, rosy cheeks.

    B. The writing of formal, end-of-year examinations is a valuable academic experience for students who have not clearly mastered their year's work. Students with year's averages above 80% have clearly mastered their year's work. Therefore, the writing of formal, end-of-year examinations is not a valuable academic experience for students with year's averages above 80%.

13. A. There is no doubt that persons twenty-one years of age, or older, are legally entitled to vote in elections. John is not twenty-one years old. John, therefore, is not legally entitled to vote in elections.

B. There is no doubt that permission for E.C.S. students to bring their own lunches, or to go out for lunch, would please the girls. E.C.S. does not grant this permission. E.C.S., therefore, is not pleasing its students.

14. A. The most recent investigations by economists have shown that when the cost of manufacturing an item is reduced, that item comes into greater demand. Dish washers have come into greater demand. Therefore, we may say that the cost of manufacturing dish washers has been reduced.

B. Recent educational research has revealed that the more demanding teachers are of their students, the better the academic performance of their students will be. The academic performance of E.C.S. students is good. Therefore, we may say that the teachers at E.C.S. are demanding of their students.

15. A. Professional architects must try to preserve the basic forms and structures of their art. Architectural designs have changed immeasurably since the earliest buildings were erected. Therefore, today's professional architects may turn away from the basic forms and structures of their art.

B. Private schools must attempt to preserve the standards and ideals of their founders. The life styles have changed considerably since Miss Edgar and Miss Cramp were alive. Therefore, E.C.S. may now turn away from the standards and ideals of its founders.

16. A. Living-room furniture which is filled with a fluffy material called 'down' is very comfortable. Some living-room furniture is not filled with 'down'. Therefore, this furniture is not very comfortable.

B. Students who participate in school functions are an asset to our school. Some students do not participate in school functions. Therefore, these students are not an asset to our school.

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1. All TEKSASTOPSES ARE MALPIGIENSES. No MALPIGIENSES are TIESCAMBIA. Therefore, no TIESCAMBIA are TEKSASTOPSES.[1]

2. Hot dogs are better than nothing. Nothing is better than steak. Therefore, hot dogs are better than steak.[2]

3. $X = Y \; ; \; Y = Z$

$\therefore X = Z$

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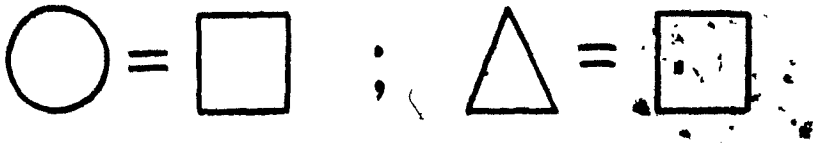
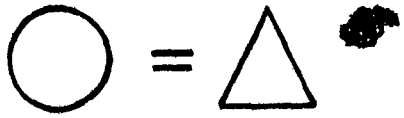
[1] This problem is taken from the work of Wilkins (1928, p. 15).

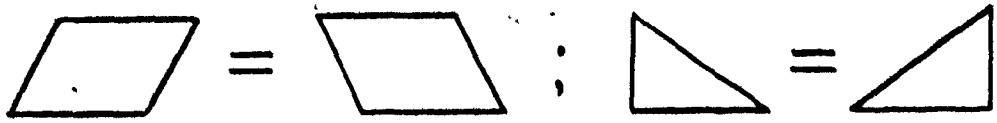
[2] This problem is taken from the work of Johnstone (1964, p. 192).

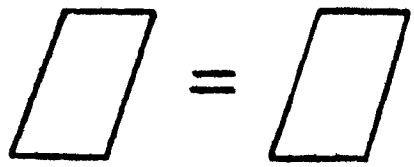
4. 

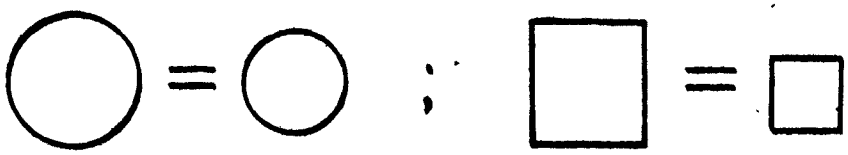
$\therefore$ 

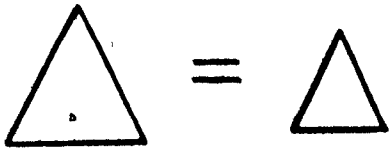
5. 

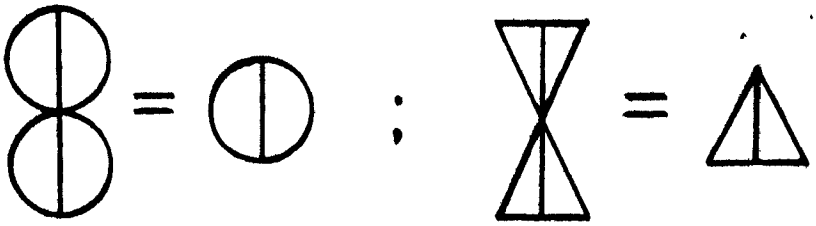
$\therefore$ 

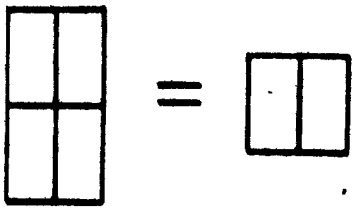
6. 

$\therefore$ 

7. 

∴ 

8. 

∴ 

The Opinion Questionnaire

1. E.C.S. (must, must not) continue to enforce the wearing of a school uniform.

2. The students at West Hill High School (do, do not) learn more effectively than the students at E.C.S.

3. The school Prefects (should, should not) be granted special privileges.

4. Morning assembly (should, should not) include prayers and hymn singing.

5. The wearing of jeans on school grounds (is, is not) good and/or desirable for the welfare of E.C.S.

6. Attendance at all classes (should, should not) be compulsory for teenagers.

7. The members of the teaching staff (must, must not) have a vote in the election of the school Prefects.

8. Weak students (must, must not) be allowed to participate in extracurricular activities.

9. The attainment of repeatedly high marks in school (is, is not) valid indication of an intelligent girl.

10. The students of E.C.S. (are, are not) taught by well trained, dedicated teachers.

11. Students who avoid consistent hard work on homework assignments (will, will not) fail their June examinations.

12. The writing of formal, end-of-year examinations (is, is not) a valuable academic experience for students with year's averages above 80%.

13. E.C.S. (is, is not) pleasing its students.

14. Teachers at E.C.S. (are, are not) demanding of their students.

15. E.C.S. (may, may not) now turn away from the standards and ideals of Miss Edgar and Miss Cramp.

16. Students who do not participate in school functions (are, are not) an asset to our school.

APPENDIX B

TABLES OF RAW DATA

Included in this appendix are the individual responses to each of the paired reasoning test items and the corresponding opinion questionnaire statements.

Responses to the neutral and affective problems, labelled A and B respectively, are coded as follows:

1 = correct
0 = incorrect

Responses to the opinion questionnaire statements, labelled O, are coded as follows:

C = opinion concordant with the conclusion presented in the affective problem
D = opinion discordant with the conclusion presented in the affective problem

AGE GROUP 1		TEST ITEMS															
S_s	AGE	1			2			3			4			5			6			7			8		
		A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O
1	14; 6	1	1	D	1	1	D	1	1	C	1	0	D	1	1	C	1	0	D	1	1	C	1	1	C
2	14; 6	1	1	C	1	0	D	1	0	D	0	0	D	1	0	D	1	0	D	1	1	C	1	0	D
3	14; 6	1	1	C	1	1	D	1	1	D	1	1	D	1	1	C	1	1	D	1	1	C	1	1	D
4	14; 8	1	1	D	1	1	C	1	1	D	1	1	D	1	1	D	1	1	C	1	1	D	1	1	D
5	14; 8	1	0	D	1	0	D	1	1	D	1	0	D	1	0	C	1	0	D	1	0	D	1	0	D
6	14; 8	1	1	D	1	1	D	1	1	D	0	1	D	1	1	C	1	1	D	1	1	C	1	1	D
7	14;10	1	1	D	1	1	C	1	1	C	1	0	D	1	1	D	1	1	D	1	1	C	1	1	D
8	14;11	0	1	C	1	0	D	1	1	C	1	1	D	1	1	C	1	0	C	1	1	D	1	0	D
9	14;11	1	0	C	0	0	D	1	1	C	1	1	C	1	0	C	1	1	D	1	0	D	1	0	D
10	14;11	1	0	D	1	0	D	1	0	D	1	0	D	1	0	D	1	1	C	1	0	D	1	0	D
11	14;11	1	1	C	1	1	D	1	1	D	1	1	D	1	1	D	1	1	D	1	1	D	1	1	C
12	15; 0	1	1	C	1	0	D	1	1	C	1	1	D	1	1	D	1	1	C	1	0	D	1	1	D
13	15; 0	1	1	C	1	0	D	1	0	D	1	0	D	1	0	D	1	0	D	1	1	C	1	1	C
14	15; 0	0	1	C	1	0	D	0	1	C	1	0	D	1	1	C	1	0	D	1	0	D	1	0	D
15	15; 0	1	1	D	1	0	D	1	0	C	1	0	D	1	1	C	1	1	C	1	1	C	1	0	D
16	15; 1	1	1	C	1	0	D	1	1	C	1	1	D	1	1	C	1	0	D	1	1	C	1	1	C
17	15; 1	1	0	D	1	0	D	1	1	C	1	1	C	1	1	C	1	0	D	1	1	C	1	1	D
18	15; 2	1	1	C	1	1	D	1	1	C	1	1	D	1	1	D	1	1	C	1	1	D	1	1	D
19	15; 4	1	0	C	1	0	D	1	0	D	0	1	C	1	0	C	1	1	D	1	0	D	1	1	D
20	15; 5	1	1	C	1	1	D	1	1	C	1	1	D	1	1	C	1	1	C	1	1	C	1	1	D

AGE GROUP 1 (Continued)		TEST ITEMS															
S_s	AGE	9			10			11			12			13			14			15			16		
		A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O
1	14; 6	0	0	D	0	0	C	1	0	C	0	0	D	0	0	C	0	0	C	1	1	C	1	0	C
2	14; 6	1	1	D	0	1	C	0	1	D	1	1	D	0	0	D	1	0	C	1	1	D	1	1	D
3	14; 6	1	1	D	0	1	C	1	1	D	1	1	D	1	0	D	1	1	C	1	1	D	1	1	C
4	14; 8	1	1	C	0	1	C	1	1	C	1	0	C	1	1	C	1	1	C	1	1	C	1	1	C
5	14; 8	0	1	D	0	1	C	1	1	D	1	0	C	1	0	C	1	1	C	1	0	C	1	1	C
6	14; 8	0	1	D	0	1	C	1	0	D	1	0	C	0	1	C	1	1	C	0	0	C	0	0	C
7	14;10	0	0	C	0	0	C	1	0	C	1	0	C	1	1	D	1	0	D	1	1	C	1	0	C
8	14;11	1	1	D	0	0	D	0	1	C	1	0	D	1	1	D	1	0	C	1	1	C	1	0	C
9	14;11	1	0	D	0	0	C	0	1	D	1	0	D	0	1	D	1	0	D	1	1	C	1	0	D
10	14;11	1	0	C	1	1	C	1	1	D	1	1	D	1	0	C	0	1	C	1	0	C	1	1	D
11	14;11	0	0	C	0	0	D	0	1	D	0	0	C	0	0	D	1	0	C	1	1	C	1	0	C
12	15; 0	1	1	D	0	0	C	1	1	D	1	1	D	1	1	D	1	1	C	1	1	C	1	1	C
13	15; 0	1	0	C	0	0	C	1	1	D	1	1	D	0	1	D	1	1	D	1	1	D	1	1	D
14	15; 0	1	0	C	0	1	D	1	1	D	1	0	C	0	1	D	1	0	C	0	1	C	1	1	D
15	15; 0	0	1	D	0	1	C	1	1	D	1	0	C	1	0	C	1	1	D	1	0	C	1	0	C
16	15; 1	0	1	D	0	0	C	0	1	D	1	1	D	1	0	C	1	0	C	0	0	C	1	0	C
17	15; 1	1	1	D	0	0	C	1	1	D	1	0	C	1	1	D	1	0	C	1	1	C	1	1	C
18	15; 2	0	0	C	0	1	C	0	1	D	1	0	D	1	0	C	0	0	C	1	1	D	0	0	C
19	15; 4	0	1	D	1	1	C	1	1	D	0	0	D	1	1	D	1	0	C	1	1	D	0	0	C
20	15; 5	1	1	C	1	0	C	0	1	D	0	0	D	0	0	D	0	0	C	1	1	C	0	0	C

AGE GROUP 2		TEST ITEMS															
S_s	AGE	1			2			3			4			5			6			7			8		
		A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O
21	15; 6	1	1	C	1	0	D	1	1	C	1	1	D	1	1	C	1	1	D	1	1	C	1	1	D
22	15; 6	1	1	C	1	0	D	1	0	D	1	1	C	1	1	C	1	1	C	1	1	C	1	1	D
23	15; 6	1	1	C	1	1	D	1	1	D	1	1	D	1	1	C	1	1	D	1	0	D	1	1	D
24	15; 7	0	0	D	1	0	D	1	0	D	1	0	C	1	0	D	1	1	C	1	1	D	1	0	D
25	15; 8	1	1	C	1	0	D	1	0	D	1	0	D	1	0	D	1	0	D	0	1	C	0	0	D
26	15; 8	0	1	C	1	1	D	1	0	D	1	1	C	1	1	C	0	1	C	1	1	D	1	1	D
27	15; 8	1	0	D	1	0	D	1	0	D	1	1	D	1	0	D	1	1	D	1	1	D	1	0	D
28	15;10	1	1	D	1	0	D	1	0	D	1	0	D	1	0	D	1	1	C	1	1	C	1	0	D
29	15;11	0	1	C	1	0	D	1	1	C	1	1	D	1	1	C	1	1	C	1	1	C	1	1	D
30	16; 0	0	0	D	0	0	D	1	0	C	1	1	D	1	1	C	1	1	C	1	0	D	1	1	D
31	16; 0	1	1	C	1	0	D	1	1	D	1	1	D	0	1	D	1	1	C	1	1	C	1	1	D
32	16; 0	1	1	D	1	1	D	1	1	C	1	1	D	1	1	D	1	1	C	1	0	D	1	1	D
33	16; 0	1	1	C	1	1	D	1	0	D	1	0	D	1	0	C	1	1	C	1	0	D	1	0	D
34	16; 1	1	1	C	1	1	D	1	1	C	1	1	C	1	1	C	1	1	C	1	1	C	1	0	D
35	16; 1	1	1	C	1	1	D	1	1	D	1	1	C	1	0	C	1	0	D	1	1	C	1	0	D
36	16; 1	1	1	C	1	0	D	1	1	C	1	1	D	1	1	C	1	1	C	1	1	C	1	1	D
37	16; 2	1	1	D	1	0	D	0	0	D	0	0	D	1	0	D	1	1	D	1	0	D	1	0	D
38	16; 2	1	1	C	1	0	D	1	1	D	0	0	D	1	0	D	1	0	D	1	1	C	1	0	D
39	16; 3	1	0	D	0	0	D	1	1	D	1	0	D	1	1	D	1	0	D	1	1	D	1	1	D
40	16; 4	1	1	C	1	0	D	1	0	D	0	1	C	1	1	C	1	0	C	1	1	D	1	0	D

AGE GROUP 2 (Continued)		TEST ITEMS															
S_s	AGE	9			10			11			12			13			14			15			16		
		A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O
21	15; 6	1	1	D	1	0	C	1	1	D	1	1	D	0	1	D	1	0	C	1	1	D	1	0	C
22	15; 6	0	1	D	1	0	C	1	1	D	1	1	D	0	0	D	1	0	C	1	1	C	1	0	D
23	15; 6	0	0	C	0	0	C	1	1	D	0	1	D	1	1	D	1	0	D	1	1	D	1	1	D
24	15; 7	1	1	D	1	1	C	1	1	D	1	0	C	1	0	C	1	0	C	1	0	C	1	0	C
25	15; 8	1	0	D	0	1	D	1	0	C	0	1	D	1	0	D	1	0	C	1	1	D	1	0	C
26	15; 8	0	1	C	0	1	D	1	1	D	1	0	C	1	1	C	1	0	C	1	1	C	1	1	C
27	15; 8	1	0	C	1	0	C	1	1	D	1	1	D	1	1	D	0	0	C	1	1	C	1	1	C
28	15;10	0	0	C	1	1	D	1	1	D	0	0	C	1	0	C	0	0	C	1	0	C	1	1	D
29	15;11	0	0	D	1	1	C	1	0	D	1	1	D	1	1	D	0	0	C	0	1	D	1	1	C
30	16; 0	0	1	D	0	0	C	0	1	D	0	0	C	1	0	C	0	0	C	0	1	D	1	0	C
31	16; 0	1	1	D	1	0	C	1	0	D	0	1	D	0	0	D	1	0	C	0	1	D	1	0	C
32	16; 0	0	0	D	0	0	D	1	1	D	1	1	D	1	0	C	0	0	C	1	1	D	0	0	C
33	16; 0	0	1	D	0	0	C	1	1	C	1	0	C	1	0	C	1	1	C	1	1	C	1	1	C
34	16; 1	1	0	D	0	0	C	0	1	D	0	0	D	1	0	D	0	0	C	1	1	D	0	0	C
35	16; 1	0	0	D	0	0	C	0	1	D	1	1	D	1	1	D	0	0	C	1	0	C	1	1	D
36	16; 1	0	1	D	1	0	C	1	1	D	1	0	D	1	1	D	0	0	D	1	1	D	1	1	C
37	16; 2	1	1	D	1	1	D	1	1	D	1	1	D	1	0	C	1	1	D	1	0	C	1	0	D
38	16; 2	1	1	D	0	1	D	1	1	D	0	1	D	0	0	C	0	0	C	1	0	C	0	0	D
39	16; 3	1	1	D	0	0	D	1	1	D	1	1	D	0	1	D	1	0	C	1	1	D	1	0	C
40	16; 4	0	1	C	1	0	C	1	1	D	1	0	D	1	0	C	1	0	C	1	1	D	1	0	D

AGE GROUP 3		TEST ITEMS																							
S_s	AGE	1			2			3			4			5			6			7			8		
		A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O
41	16; 6	1	1	C	1	0	D	0	1	C	1	0	D	1	1	C	1	1	C	1	1	C	1	0	D
42	16; 6	0	0	D	1	0	D	0	0	D	1	1	C	1	0	D	1	0	C	1	0	D	1	0	D
43	16; 6	1	1	C	1	1	D	1	1	C	1	1	D	1	1	C	1	1	C	1	1	D	1	1	D
44	16; 6	0	0	D	1	1	D	1	1	C	1	0	D	1	1	D	1	1	C	1	1	C	0	1	D
45	16; 8	0	0	D	1	0	D	1	1	C	1	1	C	1	1	C	1	1	C	1	1	C	1	1	C
46	16; 8	0	1	C	1	0	D	1	1	D	1	0	D	1	1	C	1	0	D	1	0	D	1	0	D
47	16;10	1	1	C	1	1	D	1	1	D	0	1	D	1	1	D	1	1	D	1	1	C	0	1	D
48	16;10	1	0	D	1	0	D	1	1	D	1	1	D	1	1	D	1	1	C	1	1	D	1	1	D
49	16;10	1	1	C	0	0	D	1	1	C	1	1	C	1	0	C	1	1	C	1	0	D	1	1	D
50	16;11	1	1	C	1	0	D	1	1	C	1	0	D	1	1	C	1	0	D	1	1	C	1	0	D
51	17; 0	1	1	C	1	0	D	1	0	D	1	0	D	1	0	D	1	1	C	1	0	D	1	0	D
52	17; 1	1	1	C	1	0	D	1	1	C	1	0	D	1	0	D	1	0	D	1	1	C	1	0	D
53	17; 1	0	1	C	1	1	C	1	1	C	1	1	C	1	1	C	1	1	C	1	1	C	1	1	D
54	17; 2	1	1	C	1	0	D	0	1	C	1	1	C	1	1	D	1	1	C	1	1	C	1	1	C
55	17; 4	1	1	C	1	0	D	0	1	D	1	0	D	1	0	D	0	1	D	1	0	D	1	1	D
56	17; 5	1	0	D	1	0	D	1	1	C	1	1	C	1	0	C	1	1	C	1	1	C	1	1	D
57	17; 6	1	1	D	1	0	D	1	1	C	1	1	D	1	1	C	1	1	C	1	1	C	1	1	D
58	17; 6	0	1	C	1	0	D	1	1	C	1	1	D	1	1	C	1	1	D	1	1	C	1	1	D
59	17; 7	0	1	C	1	0	D	1	1	C	1	0	D	1	1	D	1	1	C	1	1	C	1	0	D
60	17; 7	1	1	C	1	0	D	1	1	C	1	1	D	1	0	D	1	0	D	1	1	D	1	1	D

AGE GROUP 3 (Continued)		TEST ITEMS															
S_s	AGE	9			10			11			12			13			14			15			16		
		A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O
41	16; 6	1	0	C	1	0	C	1	1	D	1	1	D	0	0	D	1	0	C	1	0	C	1	1	C
42	16; 6	0	0	C	1	0	C	1	1	D	1	1	D	1	0	D	1	0	C	1	1	D	1	1	D
43	16; 6	1	1	D	1	0	C	1	0	D	1	1	D	1	0	C	1	0	C	1	1	D	1	0	C
44	16; 6	0	0	D	1	1	C	1	1	D	1	0	D	1	0	D	1	0	D	1	1	C	1	0	D
45	16; 8	1	0	C	1	0	C	0	1	D	1	1	D	0	1	D	1	0	C	0	0	C	1	0	D
46	16; 8	0	0	D	1	0	C	1	1	D	1	1	D	1	1	D	1	0	D	0	1	C	1	0	D
47	16;10	0	1	D	0	0	C	1	1	D	0	0	D	0	1	D	1	0	C	0	1	C	1	1	C
48	16;10	0	1	D	1	0	D	0	1	D	1	1	D	0	1	D	0	1	D	0	0	C	1	1	C
49	16;10	1	0	C	0	0	C	0	1	C	1	1	C	1	0	C	1	0	D	1	0	C	1	1	C
50	16;11	1	0	C	0	0	C	0	1	C	1	1	D	1	0	C	1	0	D	1	0	C	1	1	C
51	17; 0	1	0	C	1	0	C	1	1	D	1	0	C	1	0	D	1	0	C	1	0	C	1	0	C
52	17; 1	0	1	D	1	1	C	1	1	D	0	0	D	1	0	C	1	0	C	0	1	C	1	1	D
53	17; 1	0	0	D	0	0	D	0	1	D	1	1	C	0	1	C	1	0	C	1	1	D	1	1	D
54	17; 2	1	1	D	1	1	C	1	1	D	0	1	D	1	0	D	1	1	C	1	1	C	1	1	C
55	17; 4	0	1	D	0	0	C	1	1	C	0	0	D	0	1	D	0	0	C	1	1	D	1	0	C
56	17; 5	1	1	D	1	0	C	1	1	C	1	1	D	0	1	C	1	0	C	1	1	C	1	0	C
57	17; 6	0	1	D	1	0	D	1	1	D	1	0	C	0	1	D	1	1	C	1	1	D	1	1	D
58	17; 6	1	0	C	1	0	C	0	1	C	1	0	C	0	1	D	1	0	C	1	0	C	1	1	D
59	17; 7	1	0	C	1	0	C	1	1	D	0	1	D	0	1	D	1	0	C	1	1	D	1	1	D
60	17; 7	1	0	C	1	0	D	0	1	D	0	1	D	0	0	D	1	0	C	1	1	C	1	0	C

SUPPLEMENTARY EXPERIMENT

S_s	AGE	TEST ITEMS																					
		1			2			3			4			5			6			7			8		
		A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O
1	14; 6	1	1	C	1	1	D	1	1	D	0	1	D	1	1	C	0	0	C	1	0	D	1	1	D
2	14; 7	1	1	D	1	0	D	1	0	D	1	0	D	1	1	C	1	1	D	0	1	C	1	0	D
3	14;10	1	1	C	1	1	D	1	1	C	1	1	D	0	1	C	1	1	D	1	1	C	0	0	D
4	14;10	1	1	C	1	1	D	1	1	C	1	1	D	1	0	D	1	1	D	1	1	C	1	1	D
5	14;11	1	1	C	1	1	C	1	1	C	1	1	D	1	0	D	1	0	D	1	1	C	1	1	D
6	15; 1	1	1	C	1	0	D	1	0	D	1	0	D	1	1	C	0	0	D	0	0	C	1	1	C
7	15; 4	0	1	C	0	0	D	0	1	D	0	0	D	0	0	D	1	1	C	1	1	C	1	0	D
8	15; 6	1	1	C	1	0	D	1	0	D	1	1	C	1	0	D	1	0	D	1	1	C	1	0	D
9	15; 8	1	1	C	1	1	D	1	1	C	1	1	D	0	1	C	1	1	C	1	1	C	0	1	C
10	15; 8	1	1	C	0	1	C	1	1	C	1	1	C	1	1	C	1	0	D	1	1	C	1	1	D
11	15;11	1	1	C	0	1	C	1	1	C	1	1	C	1	1	D	1	1	C	1	1	C	1	1	D
12	15;11	1	1	D	1	1	D	1	0	D	1	0	D	0	0	D	1	0	D	1	0	D	1	0	D
13	15;11	1	1	C	1	1	D	1	1	D	0	1	C	1	1	C	1	1	D	1	1	C	1	1	D
14	16; 4	1	0	D	0	1	C	0	1	D	1	1	C	1	0	D	1	0	D	1	1	C	1	0	D
15	16; 8	1	1	C	1	1	D	1	1	C	1	1	C	1	0	D	1	1	D	1	1	C	1	1	C
61	16;11	1	0	D	1	1	D	1	1	C	1	0	D	1	1	C	1	1	C	0	1	D	1	1	C
17	17; 1	1	1	C	1	1	C	1	1	C	0	1	C	1	1	C	1	1	C	1	0	D	0	1	C
18	17; 2	1	0	D	1	0	D	1	1	C	1	1	D	1	0	D	0	0	D	1	1	C	1	0	D
19	17; 3	1	0	D	1	0	D	0	1	D	1	0	D	0	1	C	1	1	C	1	0	D	1	1	C
20	17; 5	0	1	D	1	1	D	1	1	C	1	1	D	1	1	C	1	1	C	1	1	C	1	1	D

(Continued)

Ss	AGE	TEST ITEMS															
		9			10			11			12			13			14			15			16		
		A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O	A	B	O
1	14; 6	0	1	D	0	0	C	1	1	C	1	0	D	0	1	D	0	0	D	0	0	C	1	1	C
2	14; 7	1	1	D	1	1	C	1	1	D	1	0	C	1	1	D	1	0	D	1	0	C	1	1	D
3	14;10	1	1	D	1	1	C	1	1	D	1	1	D	0	1	D	1	0	C	0	1	C	1	1	D
4	14;10	0	1	D	1	1	C	1	1	D	1	1	D	1	1	D	1	1	C	1	1	D	1	1	C
5	14;11	0	0	C	0	1	C	1	1	D	0	1	C	0	1	C	1	0	C	1	1	D	1	0	C
6	15; 1	1	1	C	1	0	C	1	1	C	1	1	D	1	1	D	0	0	C	1	1	D	1	1	C
7	15; 4	0	0	C	1	1	C	0	0	C	1	1	C	1	1	D	1	0	C	1	1	C	0	1	C
8	15; 6	1	0	C	0	1	C	1	1	D	1	0	D	1	1	D	1	0	C	0	1	D	1	1	D
9	15; 8	1	0	C	0	0	C	0	0	D	0	0	C	0	0	C	0	0	C	1	1	D	1	0	C
10	15; 8	1	1	D	1	0	C	0	0	C	0	0	D	1	0	C	0	0	C	1	1	D	1	0	C
11	15;11	0	0	D	0	0	C	1	1	D	1	1	D	0	1	D	1	1	C	0	1	C	1	1	D
12	15;11	1	1	D	1	0	C	1	1	D	0	1	D	1	1	D	1	1	D	1	1	C	1	0	D
13	15;11	0	0	C	0	0	C	0	0	D	1	1	D	0	0	C	0	0	C	1	1	C	0	0	C
14	16; 4	1	1	D	1	0	C	0	0	D	0	0	C	1	1	D	1	0	C	1	1	C	1	0	C
15	16; 8	1	0	C	0	0	C	1	0	C	1	1	D	0	0	C	0	0	C	0	1	D	1	0	C
16	16;11	1	1	D	1	0	C	1	1	C	1	1	D	1	0	C	1	0	C	1	1	C	1	0	C
17	17; 1	0	0	C	0	0	C	0	0	C	0	0	C	1	0	D	0	0	C	1	1	C	0	0	C
18	17; 2	0	1	C	1	0	C	1	1	D	1	1	C	1	1	D	1	1	C	1	1	C	1	0	C
19	17; 3	1	0	C	1	0	C	1	1	D	1	1	D	1	0	C	1	1	C	1	0	C	1	1	D
20	17; 5	0	0	C	0	0	C	0	0	D	0	0	C	0	0	D	0	0	C	0	1	D	0	0	C