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AN INVESTIGATION OF THE RELATIONSHIPS AMONG COGNITIVE STYLE, CROSS-MODAL TRANSFER AND READING ABILITY

by

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CHAPTER I

INTRODUCTION

The purpose of this study is to assess relationships among cognitive style, cross-modal transfer and reading ability. The specific questions under investigation are:

1. Will remedial (retarded) readers score lower in Auditory-Visual and Visual-Auditory cross-modal tasks than normal readers?
2. Will cognitive style (Field-dependence-independence dimension) affect performance in cross-modal tasks? That is, will field-dependent children show deficiencies in Visual-Auditory and Auditory-Visual integration ability?

Recently, increasing attention has been paid to retarded readers who, despite apparently adequate faculties and conventional instruction, do not acquire adequate reading skills. Benton (1962) defines specific dyslexias, whether developmental or acquired, simply as "those which cannot be dismissed as being partial expressions of a more pervasive disability", such as generalized language impairment or mental retardation. Money (1962) also noted that "there is a growing body of medical opinion that some cases of reading failure represent not poor instruction; not a dearth of motivation from an impoverished, illiterate family and neighborhood; and not ocular disability (Money, 1962, p. 12)."

Reading disabilities have come to be defined primarily by exclusion while questions regarding the identification of deficient processes which might mediate the failure to develop reading skills have remained essentially unanswered.

Cross-modal behavior has begun to be viewed as an area of possible major significance in the learning difficulty of retarded readers (Beery, 1967; Birch & Belmont, 1964, 1965; Katz & Deutsch, 1963; Meuhl & Kremenak, 1966; Sterritt & Rudnick, 1969; Blank & Bridger, 1966; Rudnick, Sterritt & Flax, 1967; Senf, 1969; Senf & Feshback, 1970; Senf & Freundl, 1971; Vande Voort, 1972). This term refers to a wide variety of tasks which involve the presentation to the subject of information by means of two or more sensory modalities (e.g., visual, auditory, tactual, etc.). The child has to use the information acquired through one sensory modality (e.g., vision) in solving problems presented to another modality (e.g., hearing). For example, a typical cross-modal task the child has to determine which visual dot pattern (e.g., /.../.. ./.. ..) corresponds to an auditory sequence (e.g., tap, tap -- long pause -- tap, tap) (Birch & Belmont, 1964).

While such tasks are in some ways analogous to the reading process, the exact nature of the relationship between reading retardation and cross-modal learning has not been determined. Because of the concept of perceptual dysfunctioning in reading retardation (Benton, 1962), however, poor cross-modal learning has generally been viewed as stemming from a basic deficiency in intersensory perception.

Recent work on the memory and attentional functioning of retarded readers (Senf, 1969; Senf & Freundl, 1971) suggests that immediate memory might be a critical factor in Birch's Auditory-Visual matching paradigm. The initial stimulus pattern may be less well remembered for comparison with the second pattern by retarded readers. However, the study of Vande Voort, et al. (1972) showed that short-term memory did not explain the retarded readers' inferior performance. Even when the auditory and visual patterns were simultaneously available for matching, the retarded readers performed more poorly. The experimenters suggest that deficiencies in the encoding processes where complex stimulus configurations are involved could account for the inferior performance of the retarded readers.

Blank et al. (1971), after studying the differences in reaction time between retarded and normal readers, suggest that failure in adopting the appropriate set (i.e., ignoring the attraction of perceptual characteristics) can be attributed to retarded readers' poor performance in cross-modal tasks.

This suggestion might contribute to retarded readers' cognitive style as manifested in a given perceptual task. Cognitive styles are defined by the characteristic, self-consistent modes of functioning which individuals show in their perceptual and intellectual (that is, cognitive) activities. These cognitive styles are manifestations in the cognitive sphere of still broader dimensions of personal functioning which cut across diverse psychological areas (Witkin, et al., 1971). Clements and Peters (1962) suggest that pervasive, perceptual disorganization may underlie the emotional liability, impulsivity, and distractibility often associated with learning problems. These authors implicate perceptual functions involving ability "to receive, hold, scan, and selectively screen out stimuli in sequential order" (p. 21). Such functions appear related to the cluster of perceptual and cognitive characteristics described by H.A. Witkin and his colleagues under the field-dependence-independence construct (Witkin et al., 1962) and to involve reflection-impulsivity as proposed by J. Kagan and his co-workers (1964).

Field dependence-independence describes characteristic ways in which individuals organize their perceptual world. Field-independence refers to a perceptual style which is analytic, differentiated, and which "reflects ability to overcome the influence of an embedding context (Witkin, et al., 1962)". Field-dependence refers to a more diffuse, less differentiated perceptual mode. Stated simply, the field-dependent person is strongly influenced by global aspects of his perceptual world; the field-independent person is better able to perceive and utilize discrete elements of the field, is less influenced by overall characteristics of the background, is better at tasks which require identification of stimuli surroundings embedded in complex backgrounds. Field-dependence-independence is considered to be the perceptual expression of a more generalized dimension of individual differences, the global-analytic cognitive style. Field-independent persons are primarily analytic, field-dependent persons primarily global, in the perceptual and cognitive strategies they bring to problem-solving situations.

Reflection-impulsivity, as proposed by Kagan, refers to the tendency to reflect over alternative solutions or classifications in which several response alternatives are available simultaneously (Kagan et al., 1964). The reflective child is able to delay immediate response and to consider other possible solutions or choices; the impulsive child responds with the first possible answer or choice. Reflection and the ability to differentiate relevant from irrelevant aspects of a stimulus have been shown to be major contributors to the production of analytic concepts (Kagan et al., 1964). Although relationships of field-dependence-independence and reflection-impulsivity are not entirely clear, aspects of both involve styles of analysis of a stimulus complex. Both have relevance to the perceptual and cognitive characteristics of children with learning problems.

Styles of perceptual and cognitive organization have implications for educational programs, in that most school learning tasks require analysis and organization of stimuli. Witkin(1973) contends that "the individual who, in perception, cannot keep an item separate from the surrounding field is also likely to have difficulty with the kind of problem that requires taking some critical element out of the context in which it is presented...(p. 6)". Dickstein (1968) also demonstrated that field-independent subjects were better able to analyze the stimulus complex and ignore the irrelevant dimension than field-dependent subjects.

Research on reading shows that cognitive style does appear related to reading ability. That is, children with reading difficulties tend to be field-dependent (Robbins, 1962; Stuart, 1967; Severson, 1962; Keogh & Denlon, 1972; Bruinkinks, 1969; Wineman, 1971). However, the relationships among cognitive style, cross-modal transfer and reading ability have not been reported. In this sense, the present study is an exploratory one.

In the following chapter, the role of perception (auditory and visual) as it relates to reading ability is reviewed in detail. Also included in Chapter II is an overview of theory and research pertaining to the cognitive style (field-dependence-independence) dimension.

Chapter III contains a description of the experimental design and of the methods employed in the collection of data, and Chapter IV the results of the investigation. Chapter V contains discussions about the results of the study. Practical implications of the major findings are also discussed in Chapter V, and suggestion for future research are set forth.

CHAPTER II

REVIEW OF RELATED RESEARCH

Cross-modal Integration and Reading Ability

In the past half century, attention has been directed to perceptual and cognitive factors that are related to reading retardation. Bronner (1917) attempted to relate visuo-perceptive skills to reading proficiency, although she dealt with only a few cases. Monroe (1932) reported that retarded readers differed from unselected first grade controls on tests both of auditory discrimination and of the ability to associate auditory and visual symbols. It should be noted, however, that her control group (normal readers) was ten points higher in mean IQ. Goins (1958) found a significant correlation between visuoperceptive skills and intelligence among the first graders. Lachman (1960) found that on the Bender Gestalt Test, retarded readers (aged 8-10 to 9-11) performed more poorly than either an age-matched group of normal children or a group of emotionally disturbed children. When he compared three similar groups of older children (aged 10-0 to 10-11), however, he found that the Bender Gestalt performance did not differ between the emotionally disturbed and dyslexic groups, though both groups made significantly more errors than did normal Ss. Lachman's evidence is countered by that of Malmquist (1958), who found no relationship between visual perceptual ability and reading skills among first graders.

The relationship between auditory discrimination and reading skills has also been investigated. Wepman (1962) selected a sample of first and second grade Ss who showed poor auditory discrimination. He found that this group of children was also significantly deficient in reading skills. However, he did not suggest that poor auditory discrimination is the sole cause of reading retardation. He noted that "similar difficulties in reading are now being found in children with adequate auditory discrimination but inadequate development of prereading visual skills (Wepman, 1962, p. 184)".

The evidence indicates that while visual and auditory perceptual deficits may account for some instances of deficient reading skills, these deficiencies alone cannot account for the majority of the cases of reading retardation.

Recently, in the study of reading retardation more attention has been directed to the role of higher-level processes, in situations where stimuli are presented simultaneously or alternately to both auditory and visual modalities. Birch and Belmont (1964) hypothesized that "one among the several possible causes for subnormality in learning to read could be a primary inadequacy in the ability to integrate visual and auditory stimuli (p. 853)". This notion was based on an earlier study by Birch and Lefford (1963) which investigated the hypothesis that intersensory integrative functions develop through childhood. Intersensory integration was defined by Birch and Lefford as the process of recognizing the equivalence of stimuli arriving from two different sensory modalities (e.g., visual, auditory). Accordingly, their test of intersensory integration involved the matching of stimulus patterns received from two different senses. They found that older Ss performed more adequately on such a test than did younger ones, and concluded that "intersensory integration" is a developmental skill.

Birch and Belmont (1964, 1965) suggest that the ability to match or integrate stimuli across sensory modalities might also relate to the development of reading skills. They specifically singled out the integration of visual and auditory stimuli as being particularly important in this regard. In an attempt to assess the relationship of intersensory integration to reading skills among grade school children selected without regard to reading level, they used a task in which subjects were exposed to patterns of pencil taps with short intervals of .5 second and long intervals of 1 second between taps. The Ss were required to choose from among three patterns of dots presented on 5 x 8 inch cards the one that represented the visual equivalent of the pattern of auditory pencil taps. The investigators found that the ability to match an auditory pattern of pencil taps to a visual configuration of dots increased with age throughout elementary school. It was also noted that among first graders, task performance was more highly correlated with reading proficiency test results than with IQ scores. The authors suggested that their findings supported the notion set forth earlier by Birch and Lefford (1963) that an "intersensory integrative function" develops with age (at least through the elementary school years), and that development of this function is related to the ability to read.

In an earlier study, Birch and Belmont (1964) applied the same audiovisual matching task to a clinical population of 150 boys whose reading scores were in the lowest decile on at least three of four reading tests. The same task was administered to a control group of normal readers matched for age and sex. As the authors predicted, the mean number of correct responses for the group of retarded readers was significantly below that of the control group. These results were confounded by the effects of intelligence, however, in that there was a significant difference ($p < .001$) between the mean IQ of the group of retarded readers and the mean IQ of the control group. Recognizing that the "level of auditory-visual integrative proficiency was positively related to intellectual level" (Birch & Belmont, 1964, p. 301), the authors attempted to minimize the IQ difference by post hoc elimination of Ss with IQ scores below 100. This was reported as being ineffective in eliminating the IQ difference, however, making interpretation of these data tenuous.

There are other difficulties in the Birch and Belmont (1964, 1965) conclusion that their results reflect differences in the ability to integrate stimuli from two sensory modalities. Their matching task requires skills other than intersensory integration. For example, Sterritt and Rudnick (1966), Rudnick, Sterritt, and Flax (1967), and Blank and Bridger (1966), have suggested that on the Birch and Belmont task not only must a S integrate auditory and visual stimuli but he must also match temporal stimuli to spatial ones. The visual-temporal/visual-spatial matching task which these researchers introduced to separate temporal-spatial effects from cross-modal effects has not been found to be consistently related to reading skills, however.

Further research has used different forms of temporal and spatial matching to find which aspects of these tasks are most closely correlated with reading. There is some evidence that matching temporal patterns within one modality is at least as strongly correlated with reading as cross-modal matching (Bryden, 1972).

One general criticism of all these studies comes from the observation by Kahn and Birch (1968) stating that children were using different strategies to perform the matching task. About half of them were "counting" the groups of taps, while the remainder seemed to be using visual, auditory, or proprioceptive memory. This implies that different abilities are being tested according to S's strategy.

Recently, Gregory and Gregory (1973) have devised a new test using temporal patterns similar in form to Morse code, with long or short stimuli separated by gaps of constant duration (e.g., __ . . __). They gave two auditory-visual integration tests (one developed basically by Birch, the other used Morse-type stimuli) to 86 children from 6 to 11 year-olds. The children were also given tests of nonverbal intelligence, reading ability, and vocabulary. With age and intelligence partialled out, the Morse Form of the test significantly more highly correlated ($r = .50$, $p < .01$) with reading ability than the Birch test ($r = .25$, $p < .05$). Most of the older children (over 8 years 9 months) were asked about the strategy they had used for matching the comparisons. For the Birch test, 50 per cent reported "counting", 25 per cent reported "sounding" the stimulus to themselves and about 15 per cent reported "tapping". For the Morse test only 20 per cent of the children reported using "counting", about 40 per cent reported "sounding" and 30 per cent "tapping". The above average readers tended to report a sounding method for the Morse test and "counting" for the Birch test. Gregory and Gregory (1973) concluded that:

> A high percentage of children appear to use some form of counting strategy when performing this test, suggesting that it is not pro-

> viding a direct measure of auditory-visual matching, and this may well be the reason for the low correlation with reading. The Morse form of the test has a higher correlation with reading ability, and reports on strategy show that far fewer children are using a counting or verbal strategy and more are sounding the pattern to themselves. This suggests that the Morse test provides a much more direct measure of auditory-visual matching ability, and the strong correlation with reading supports the idea that this ability is one of the important skills underlying the development of reading (p. 1066).

For the present study, the Morse form of the auditory -visual test is used.

One additional question of interest is whether the presentation of a visual stimulus as a standard to be matched by a choice among auditory alternatives (V-A method of presentation) would yield findings comparable to those results from the method of presentation utilized originally by Birch (A-V method). Since visual stimuli initiate the matching process, visual-auditory procedures appear to be more similar to the process involved in reading.

Beery (1967) used A-V, V-A test to 15 children of normal intelligence with specific reading disability and an equal number of control subjects matched for IQ, sex, and age. She hypothesized that V-A task would discriminate between normal and retarded readers to a greater degree than the A-V task itself. However, her findings show that the performance difference between retarded readers and control Ss on a V-A task were very similar to those on an A-V task. This suggests retarded readers show inferior performance both on A-V and V-A tasks.

After studying the relationship among reading achievement, reading readiness and the ability to match within and between the visual and auditory sensory modalities (V-V, A-V, V-A, A-A) with 108 first grade children Kremenak (1965) concluded that the ability to match V-A and A-V was significantly related to later reading. Her results also indicated that sensory matching tasks differed in difficulty in the following order from easiest to most difficult: V-V, V-A, A-V, and A-A. The V-V matching task was simple for all Ss of the beginning reading age whereas the A-A task was difficult for most. Of the cross-modal tasks (V-A, A-V) A-V tended to be more difficult and A-V was more (r = .40) related to reading ability than V-A (r = .30).

Blank et al. (1971), using an intramodal paradigm involving a "simple" and a "complex" visual stimulus, found that 20 retarded third-grade readers had significantly longer reaction time than 20 normal third grade readers. This finding implies that one cannot attribute poor cross-modal performance simply to deficiencies in cross-modal perception. One of the possible reasons explaining the poor cross-modal performance of retarded readers could be that retarded readers have difficulty in shifting attention from one stimulus to another due to their failure in adopting the appropriate set to the situation (i.e., ignoring the "attraction" of the perceptual characteristics in a perceptual task).

This assumption might account for the retarded readers' cognitive style as it is manifested in a given perceptual task.

In the following section, a brief review of one theory of cognitive style specifically that concerned with the field-dependence-independence dimension as developed particularly by Witkin and his co-workers (1962) and its relevance to reading will be presented.

The Field-Dependence-Independence Dimension

Recent work in the area of perception and cognition, has suggested the fact that people adopt stable and consistent modes of functioning which are manifested across a broad range of perceptual and intellectual activity as well as personality. This consistency across area is what is generally referred to as "cognitive style".

Although the field dependent-field independent cognitive style dimension identified by Witkin and his co-workers was originally thought of as a perceptual style, it has now come to be conceptualized as one manifestation of a person's general tendency to articulate and structure experience in a "global" versus an "analytic" fashion...a tendency which "pervades the individual's perceptual, intellectual, emotional, motivation, defensive, and social operations" (Witkin et al., 1962, p. 4). Witkin (1962) described

> Sitting in a tilted chair with a markedly tilted experimental room, with room and chair aligned, they (field dependent persons) are likely to experience themselves as upright. Their judgments under these circumstances are thus apt to be very inaccurate. However, the very tendency reflected by this way of performing, to be guided by the axes of the surrounding visual field rather than by sensation from within the body, causes these people to be highly accurate in determining body position in a centrifuge type of situation, where the experimental room in which they are seated is upright, and the body is pulled to one side by a strong centrifugal force. They are apt to experience themselves as appreciably shorter than they really are. When asked to draw a person, the figures they produce are likely to show few characteristics of masculinity or femininity.
> These people are likely to change their stated views on a particular social issue in the direction of the attitudes of an authority. They are also particularly attentive to the faces of those around them and, as a result, tend to be better than relatively field-independent persons at recognizing people they have seen only briefly before. ...on the whole, they favor occupations that involve contact with people and that are popular within their group.

The tests usually employed by the Witkin group to assess the individual's mode of functioning in the perceptual area are the Body-Adjustment-Test (BAT), the Rod-and-Frame-Test (RFT), and the Embedded Figures Test (EFT). In the BAT, the subject is seated on a tilted chair in a tilted room and is asked to adjust his body to an upright position. In the RFT, the subject sits in a darkened room facing a luminous rod and frame, both of which are tilted. His task is to adjust the rod to the true vertical. In the EFT, the subject is asked to locate simple geometric figures which are embedded in a series of complex geometric designs.

These tests require in common the ability to keep an item (body, rod, or simple figure) isolated from "compelling background forces" (Witkin et al., 1962). Persons who perform well on these tests are said to be "field-independent" while those who have difficulty in separating items from the embedding field are said to be "field-dependent". Although people become more field-independent with age (up to about fifteen years of age), their mode of field approach remains quite stable over long periods of time (Witkin, Goodenough, & Karp, 1967). Cognitive style should be considered as individual differences in style of adaptation but not limitations or superiority of the individual's adaptive capacity. It is an indication of divergent directions of psychological development and preferred modes of perceiving (Witkin et al., 1962). This orientation implies that people who differ in their performance on field-dependent independent tests (such as the Rod-and-Frame Test, Embedded Figures Test, etc.) differ in the very direction of development of their personalities, in the way they prefer to deal with life situations, in their strategy for living.

People who perceive in a relatively field-dependent manner in the battery of perceptual tests devised by the Witkin group show the same tendency in many other perceptual, cognitive, and social situations as well. For example, significant relationships between field-independence and a variety of intelligence tests have been reported in numerous studies with adults (e.g., Dubois & Cohen, 1970; Elliott, 1961; Wachtel, 1971), and with children (Campbell & Douglas, 1972; Corah, 1965; Pedersen & Wender, 1968).

Dickstein (1968) found that field-independence was related to concept attainment in a task containing a number of irrelevant perceptual attributes. He suggests that field-independent persons are better able to analyze the stimulus complex and ignore irrelevant dimensions than are field-dependent subjects.

Because of the relationship found between performance on perceptual and intellectual tests, Witkin has concluded that the trait "field-independence" is not limited to perception but might be interpreted as a more general capacity to structure experience in an articulated fashion. He states:

> We have adopted the term 'analytic' field approach for the style of functioning represented in both the perceptual and intellectual behavior of an individual which involves the ready ability to overcome an embedding context and to experience items as discrete from the field in which they are contained (Witkin et al., 1962, p. 80).

In contrast persons who lack this capacity are said to experience their surroundings in a relatively "global" and diffuse manner, passively conforming to the influence of the prevailing field or context. Witkin (1962) contends that early in development, individuals' experience of the body-field matrix is essentially global, and during development becomes progressively more articulated so that body, self, and objects in general are experienced as segregated. Segregation, or analysis, and with its structuring of experience - of what is outside and of what is inside - are manifestations of developed psychological differentiations. Development toward greater differentiation is manifested in the form of controls and defenses for the channelling of impulses from early life. In this sense, the individual differences in pace of progress toward greater differentiation come from differences in patterns of contributions made to development of constitutional characteristics and by particular life experiences. As children grow older they tend to become more differentiated. However, we may expect that at any age level, children would differ in extent of differentiations and that greater or more limited differentiations would be manifested in a given child in each of the indicator areas, although in varying degrees.

The bulk of research shows a positive correlation between characteristics of child rearing and field-dependence-independence (Dyk, 1969; Dyk & Witkin, 1965; Witkin et al., 1962). Cross-cultural studies also indicate that development by a more field-dependent or field-independent cognitive style is related to socialization experience (Berry, 1966, Dawson, 1971).

Cognitive Style and Reading Ability

Research related to cognitive style and reading ability is sparse. Fiebert (1967) has reported a low-level relationship between field-independence and reading ability for deaf girls, but not for deaf boys. Stuart's

(1967) results with normal children also suggest that increased field-independence may be associated with better reading skills. He used Witkin's Embedded Figures Test with 83 (47 control subjects and 36 retarded readers) 7th and 8th graders. He suggested that identification of individual perceptual styles before reading instruction is initiated might be useful for planning. His suggestion is consistent with Witkin's (1973) conclusion that educators should provide specific teaching methods specifically attuned to the student's cognitive style (field-dependence or field-independence) for improving his learning progress. For example, Spitler (1970) has spelled out alternative methods of teaching mathematics to more field-dependent and more field-independent students, each method exploiting the cognitive style of the student for whom it is intended.

Recently, Wineman (1971) studied the relationship between reading ability and cognitive style (measured by Witkin's human figure drawing test) with 270 elementary school students (Grades 4-6). His results also suggests that field-independent children are more advanced in reading ability than field-dependent children.

Will field-dependent children show deficiencies in cross-modal integration ability? If so, could the retarded readers' inferior performance in cross-modal tasks be attributed to their cognitive style? It seems to be worthwhile to study these broad questions. It could also be helpful in planning instructional method in reading for elementary students.

Hypotheses

In view of the researches reviewed, the following hypotheses are therefore basic to the present study. Since the previous researches have shown that retarded readers are generally poor on cross-modal tasks, it is expected that retarded readers will show poor ability on auditory-visual, visual-auditory cross-modal tasks than normal readers.

The previous researches suggested that field-independent subjects generally out-perform field-dependent subjects on the problem-solving tasks. Accordingly, it is expected that field-dependent readers will show poorer ability in auditory-visual, visual-auditory cross-modal tasks than field-independent readers.

Since both reading level and cognitive style are expected to influence the performance of the cross-modal tasks there may be the significant interaction effect between reading level and cognitive style.

Specific hypotheses are as follows:

1. Retarded readers will score lower on auditory-visual, visual-auditory cross-modal tasks than normal readers.
2. Field-dependent readers will score lower in auditory-visual, visual-auditory cross-modal tasks than field-independent readers.
3. The interaction effect between cognitive style and reading level will be significant.

CHAPTER III

METHOD

<u>Subjects</u>

Reading-retarded <u>S</u>s were selected from two schools in Winnipeg, Manitoba. Students from these two schools were generally from middle-class homes. From these two schools, 18 subjects (10 male, 8 female <u>S</u>s) were selected using the following criteria: (a) IQ was above 90 as measured by Stanford-Binet Intelligence Test Form L-M, 1969; (b) Reading grade level (measured by Gates-MacGinitie Reading Test Primary Form C, 1965) falls one and one-half to two years or more behind either his grade placement or the appropriate grade level for his chronological age (adopted from Rabinovitch, et al., 1954; Miller et al., 1957); (c) Multilingual <u>S</u>s and <u>S</u>s with known gross neurological sensory or emotional problems were eliminated (judged through teachers' observation and comments); and (d) the age range 9-0 to 10-11 (grades 4 and 5) was used.

The resulting sample of 18 retarded readers had a mean chronological age of 120.3 months (SD = 6.737), a mean Stanford-Binet Intelligence Test IQ 108. 78 (SD = 7.216) and a mean Reading Grade Level 2.89 (SD = .58).

The sample was then split into two groups according to the field-dependence-independence dimension as measured by the Children's Embedded Figures Test (Karp & Konstadt, 1963). The criterion score (mean score for age 9-10 year olds = 16.4) employed by Witkin et al.,(1971) was adapted for dividing retarded readers into field-dependent and field-independent groups.

For the 9 field-dependent retarded readers (4 male and 5 female) the mean chronological age was 121.67 (SD = 6.8), the mean Stanford-Binet Intelligence Test IQ was 108.22 (SD = 7.996), and the mean reading grade level was 2.88 (SD = .64).

The 9 field-independent retarded readers had a mean chronological age of 118.89 (SD = 6.772), a mean IQ of 109.33 (SD = 6.782) and a mean reading grade level 2.9 (SD = .55). (Screening test data for individual Ss may be found in Appendix A.)

Control subjects were selected from the same school as the reading retarded sample. The 18 Ss (9 male and 9 female) selected as control group met the same criteria outlined for the retarded readers except that they were required to have adequate reading skills (reading grade level was required to be the same or above than the appropriate grade level for each subject). They were also selected so that the number of Ss within each decile of Stanford-Binet IQ and within each year of age was proportional to that of the sample of retarded readers.

The resulting sample of 18 control Ss had a mean chronological age of 124.16 (SD = 6.767), a mean IQ of 110 (SD = 5.61), and a mean reading grade level of 5.41 (SD = .743). When split at the mean criterion score of the Children's Embedded Figure Test into a group of field-dependent control Ss and a group of field-independent controls, the field-independent control group had a mean chronological age of 126.778 (SD = 5.718), a mean IQ of 112 (SD = 5.196) and a mean grade level 5.7 (SD = .622). The field-dependent control group had a mean chronological age of 121.556 (SD = 7.02), a mean IQ of 108.44 (SD = 5.725), and a mean reading grade level of 5.089 (SD = .742). (Screening test data for individual control subjects may be found in Appendix A.)

Instruments

The Morse form of auditory-visual integration test was employed in this study. The auditory-visual (A-V) task of the test consists of 20 items preceded by 3 sample or practice items. Each item of this form consists of an auditory standard and three visual stimuli which served as alternatives from which the standard was to be matched.

Conversely, the twenty-item visual-auditory (V-A) version involved a visual standard and two auditory alternatives. Only two foils per item were presented for this form in an attempt to avoid excessive demands upon auditory memory.

The auditory stimulus was 900-Huze tone. The duration of the two auditory tones produced were 150 micro-seconds for the short stimulus, or 700 micro-seconds for the long stimulus with a 350 micro second interval between groups of elements. These stimulus configurations were tape-recorded.

The visual stimuli consisted of dots for short sounds and lines (1 cm length) representing long sounds. They were typed on 5 x 8 inch white cards at a distance of 0.3 cm for dots and/or lines within a group. Each visual standard (V-A form) and each set of visual alternatives (A-V form) was typed on a separate card. (Stimulus patterns are reproduced in Appendix B).

Procedure

All forms of the test were administered to each subject individually by the writer. A random half of the members of each group received the A-V form first, while the remaining half received the V-A form initially.

The experiment was conducted in a small room in each of the two elementary schools. The S sat beside the Experimenter (E) so E could easily show the stimulus card to S. If the A-V form was to be presented first, E said: "I am going to play beeps for you. First I will play a few so that you will get used to hearing them. Your job then is just to listen. Then I will play some more beeps and show you a card. It will have three sets of dots and lines on it, like this." (The E demonstrated first card.) "Dots mean short sounds and lines mean long sounds. Now, I want you to tell me whether what you heard is like the first, the second, or the third set which you see. Do you understand?" (E answered any questions S asked.) "Now, you tell me what you are going to do."

Portions of the instructions were repeated as necessary. The S was asked to point to the sets of dots/lines designated as "first", "second", and "third", and told to "turn over the card when you have finished, and put it here (E pointed)."

If the V-A task was to be presented first, E said: "I am going to play some beeps for you. First I will play a few so that you will get used to hearing them. Then, I will show you a card. Take a good look at it." The E demonstrated with the first card and continued. "After you have had a look at the card, turn it over and put it away, I will play two sets of beeps. I want you to tell me whether what you saw is like the first or the second set of beeps which you heard." During the three sample items, E reminded S of what he was required to do and prompted him if he forgot. A sample item was repeated if S requested it. After finishing the three sample items and making sure that the S understood the task, E said: "Good, I think you understand what to do now. Now, you do the rest".

Prior to the administration of the second form (either A-V or V-A) E said:

"That was fine. Now, we are going to do it a little differently," and proceeded to instruct S as to the nature of the remaining form, whether A-V or V-A.

Testing time ran about 20 minutes per child. The score for each S was his number of correct judgments.

CHAPTER IV

RESULTS

The independent variables in this study were reading levels and cognitive styles and the dependent variable was cross-modal tasks. Two-way analyses of variance were utilized for the statistical treatment.

Table 1 shows the analysis of variance of cross-modal (A-V, V-A combined) task scores. As seen in Table 1, main effect of reading level is significant, which confirms that reading level has a systematic effect on the performance of the cross-modal tasks.

TABLE 1

Analysis of Variance of Cross-Modal (A-V, V-A) Task Scores

Source	df	Sum of Squares	Mean of Squares	F
R	1	342.250	342.250	17.66**
C	1	110.250	110.250	5.69*
R x C	1	2.250	2.250	0.12
Error	32	620.222	19.382	
Total	35	1074.972		

*$p < .05$.

**$p < .01$.

Note: R = Reading level. C = Cognitive style.

Table 2 and 3 shows the analysis of variance on V-A scores and A-V scores, respectively. As indicated by Tables 2 and 3, the main effects of reading level were significant on both V-A and A-V tasks. These results confirm Hypothesis 1, that is, that retarded readers will score lower on auditory-visual, visual-auditory cross-modal tasks than normal readers.

TABLE 2

Analysis of Variance of V-A Task Score

Source	df	Sum of Squares	Mean of Squares	F
R	1	78.028	78.028	10.07**
C	1	4.694	4.694	0.61
R x C	1	2.250	2.250	0.29
Error	32	248.000	7.750	
Total	35	332.972		

*$p < .05$.

**$p < .01$.

Figure 1 shows that normal readers scored higher than retarded readers in both A-V and V-A tasks.

Attention should be paid to the finding that for both normal and retarded readers, the mean scores of V-A task are higher than the mean scores of the A-V task. The significance of this will be discussed in the next chapter.

Hypothesis 2, that field-dependent readers will score lower in A-V

TABLE 3

Analysis of Variance of A-V Task Score

Source	df	Sum of Squares	Mean of Squares	F
R	1	93.444	93.444	10.46**
C	1	69.444	69.444	7.77**
R x C	1	0.000	0.000	0.00
Error	32	286.000	8.937	
Total	35	448.889		

*$p < .05$.

**$p < .01$.

and V-A tasks than field-independent readers, was partially confirmed. As indicated in Table 1, the overall effect of cognitive style on the performance of cross-modal tasks (A-V, V-A combined) was significant at .05 level. However, the main effect of this variable failed to constitute a significant variance on the V-A task (see Table 2) whereas it yielded significant variance on the A-V task (see Table 3). Since cognitive style showed a significant effect on the performance of A-V cross-modal task, one way analysis of variance was carried out in order to determine which group was influenced by cognitive style.

Table 4 and Table 5 show the analysis of variance of A-V scores for field-dependent (F-D), field independent (F-I) retarded and normal readers. As shown in Table 4, cognitive style produced no significant effect on A-V task performance among retarded readers, while it

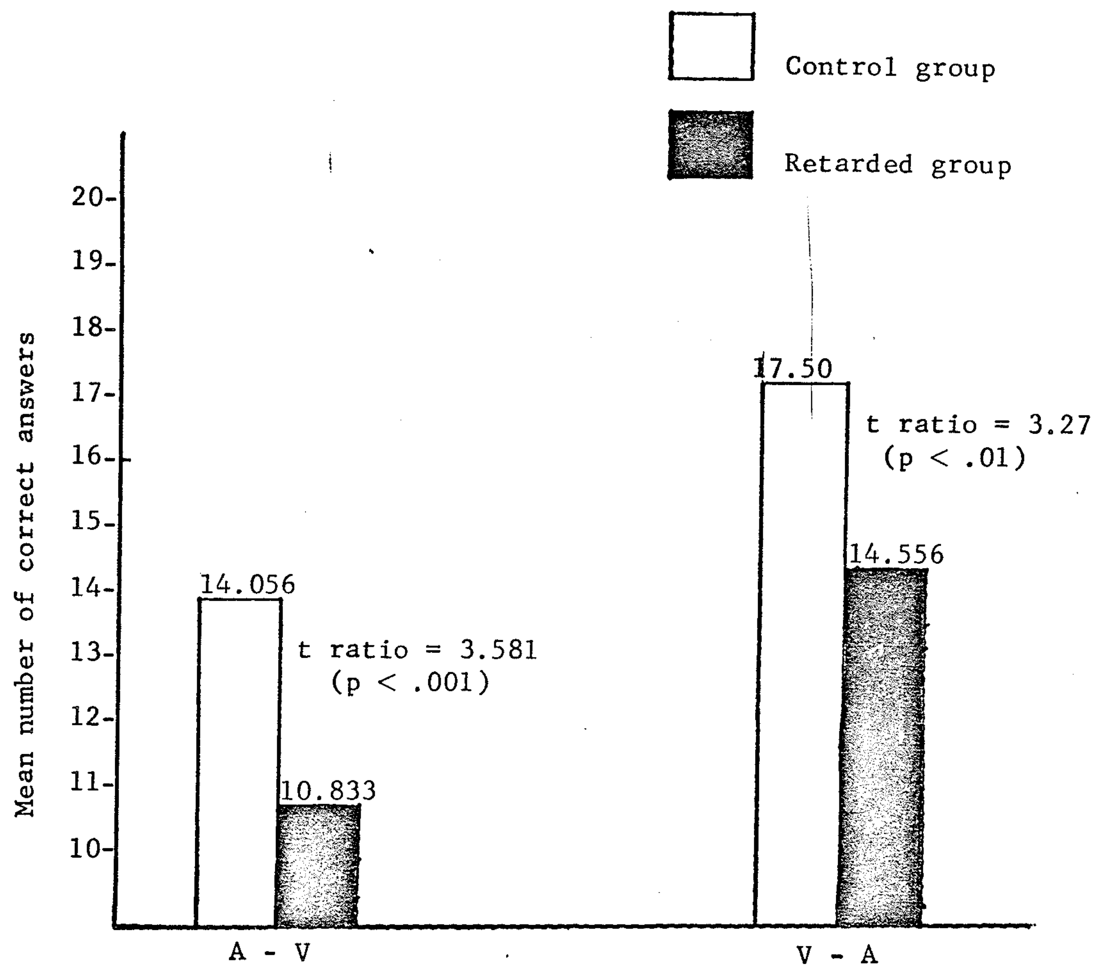

Fig. 1. Normal and retarded readers' mean number of correct answers on A-V and V-A tasks.

TABLE 4

Analysis of Variance of A-V Task Score for

Field-Dependent and Field-Independent Retarded Readers

Source	df	Sum of Squares	Mean of Squares	F
Between	1	34.722	34.722	3.351
Within	16	165.778	10.361	
Total	17	200.500		

Note: F = 4.49 is significant at .05 level.

showed a significant effect on A-V task performance among normal readers.

TABLE 5

Analysis of Variance of A-V Task Score for

Field-Dependent and Field-Independent Normal Readers

Source	df	Sum of Squares	Mean of Squares	F
Between	1	34.722	34.722	4.621*
Within	16	120.222	7.514	
Total	17	154.944		

*$p < .05$.

As a whole, cognitive style did not show a systematic effect on V-A task performance for both normal and retarded readers. It influenced A-V task performance of normal readers but not of retarded readers.

Hypothesis 3, that interaction of reading level and cognitive style will show significant effect on A-V and/or V-A task performances was not supported. As was noted in Table 1, Table 2, and Table 3, all interaction effects failed to achieve statistical significance.

CHAPTER V

DISCUSSION

The purpose of this study was to investigate the relationships among cognitive style (field-dependence-independence dimension), cross-modal transfer (auditory-visual and visual-auditory integration ability) and reading ability.

The results of the present study supported the hypothesis that retarded readers show lower scores in both A-V and V-A matching tasks. It is clear that regardless of whether a matching task involves a visual standard (V-A task) or auditory standard (A-V task) the present sample of retarded readers is deficient in their performance. One possible explanation for this result is that there are defects in attention or in the perceptual processes required to assimilate accurately the two (in V-A task) or three (A-V task) stimuli for subsequent matching. Another possible interpretation would be attributed to retarded readers' a more general deficit which could act on a variety of skills necessary for adequate matching task performance. One such general deficit might be anxiety aroused by the testing situations which could affect a variety of attentional, input, and memory processes. Because there are no measures for anxiety in the present study apart from the performance it should be taken into consideration in the future on studies of this kind.

The results of this study are comparable to those of Birch and Belmont (1964), despite certain differences in procedure and stimulus patterns, and suggest that the phenomenon they report is somewhat a general one. That means regardless of whether the standard stimulus was auditory or visual, and whether the stimulus pattern is different from Birch and Belmont's original form or not, the ability of the retarded readers to make comparisons between the auditory and visual stimuli was significantly inferior to that of the normal readers on these tasks. When the mean percentages of correct responses of normal and retarded readers in this study compared to Beery's (1967) results (She devised Birch and Belmont's 10 item original A-V task into lengthened 20-item A-V task and then made its V-A version), the close correspondence of these scores is interesting. For retarded readers, the Iowa (Beery's sample) and Winnipeg means for the A-V task were 52.3 and 50.42 per cent, respectively, and for the control subjects they were both 70.3 per cent. For the V-A task, the mean percentage of correct choices made by the Iowa and Winnipeg retarded readers were 76.4 and 70.28 per cent, respectively, as compared to 92.0 per cent for the Iowa control group and 87.5 per cent for the control group in this study. Even though the differences of mean percentages between retarded and normal readers are statistically significant for both samples, the mean scores on V-A version of Gregory's task which was employed in this study is generally lower than the Beery's V-A task for both retarded and normal readers. However, it could not be concluded at the present time that Gregory's task is more difficult than Beery's.

Of considerable interest is the finding that both normal and retarded readers' mean scores on the V-A task is much higher than the mean score on the A-V task, which means a V-A cross-modal task might be easier than an A-V task for the subjects in both groups.

This finding is consistent with Kremenak's (1965) study which showed that of the A-V, V-A cross-modal tasks, A-V tended to be more difficult. Bartholomeus and Doehring's (1972) study also showed that subjects performed better when the visual stimulus was presented first. Beery (1967) also found that the visual-auditory procedure was easier than the auditory-visual procedure for both retarded and normal readers, even though the normal readers were excelling in both conditions. In studies of visual-tactile matching (Milner & Bryant, 1970), the easier task was also the one with a visual standard. It is clear that visual tasks were easier than auditory tasks and that cross-modal matches with visual standard were easier than those with auditory standard. These findings seem to indicate that a difference exists in the manner in which visual and auditory stimuli are stored and retrieved during V-A association. Flavell (1971) contends that visual memory for words favored the early inputs of a sequence (primary), whereas auditory memory favored the later inputs (recency); retrieval of information increased with faster auditory memory showing serial position interference effects, visual memory did not; visual mnemonic capacity was extensive, auditory mnemonic capacity was limited. Consequently, visual and auditory modalities should be considered as a different information processing systems. The sequence of modality presentations does affect the performance of cross-modal tasks.

This finding suggests that when teaching reading visual tasks (i.e., letter, picture, etc.), associated with their auditory counterpart (i.e., sound) would be easier for students to store and retrieve the information than vice versa. However, the reason why V-A matching tasks are easier than A-V tasks should be answered in further study.

Furthermore, findings in this study indicate that students differ greatly in their ability to make cross-modal matchings. Some retarded readers did better in an A-V matching task than a V-A task, and the same thing happened with control subjects. Is it possible to assume that modality preference (auditory versus visual) interacts with informational demands to determine the pattern of differentiation or integration at higher levels of cognitive processing? Do genetic factors or early childhood experiences differentially bias or organize modality preference? These questions cannot be answered from the present study. But it is conceivable that when a child is instructed to take the time to think, when he hears verbal explanations (i.e., auditory), and when his own verbal output receives serious consideration, selective reinforcement of both the use of the auditory modality and a differentiating cognitive style are occurring. This might explain why Rudnick et al. (1972) and Bryden (1972) with impoverished children and retarded readers, found auditory-temporal performance to be very poor, whereas Klapper and Birch (1971), and Goldstone and Goldfarb (1966), with middle-class children, found auditory-temporal skills to develop earlier and be more advanced than visual-temporal skills.

Although middle-class children were predominantly included in this study, the social class of parents was actually disregarded in subject selection procedures, besides, the experimenter did not take into consideration the subjects' modality preference. The experimental design and subject selection procedure might affect the result in this kind of study.

Since cognitive style did not show a significant effect on V-A task performances for both normal and retarded readers, one may ask why field-dependent subjects showed no difference in their performance on V-A tasks to field-independent subjects. One may assume that the Children's Embedded Figure Test (CEFT), which assesses visual-perceptual ability, in a sense, would be more related to V-A matching ability than A-V ability. Because of the nature of the administration procedure of the CEFT in which the subject is directed to find the simple figure from a complex visual stimulus card, it may be easily assumed that visual-auditory task might be more closely related to field-dependence, field-independence dimension than auditory-visual cross-modal task. However, the above finding showed a contrasting result to our common assumption. One possible reason is that as was discussed before, the V-A task may be too easy to differentiate field-dependent subjects from field-independent subjects. Further research is required to determine whether or not the cognitive style has any relationship to V-A cross-modal matching ability.

The finding shows that field-dependence-independence dimension is related to the A-V matching task performance of normal readers, but not of retarded readers. One possible explanation for this result is that retarded readers' CEFT score is generally lower than that of normal readers (mean scores of CEFT are 15.056 and 18.389, respectively, see Appendix A). Retarded readers whose CEFT scores were above 17 fell into field-independent sub-group. This mean score of 17 (for age range 9 - 10 years) was adopted according to Witkin et al's. (1971) standardization study to differentiate field-dependence-independence. Probably the lower-scored field-independence might not play as much critical role on cross-modal matching performance as higher-scored field-independence. This means that the criterion score which determines subjects' field-dependence-independence should be reconsidered in future study.

However, these findings in the present study appear relevant to instructional and curricular aspects of classroom programs as well as to psychoeducational evaluation. Koegh (1972) has proposed that school psychologists broaden their testing repertoire to include children's problem solving strategies as test data. After investigating A-V integration skills and reading success as they are related to one demographic feature of a school, Reilly (1972) suggests that the teaching of auditory-visual integration skills should be emphasized prior to the teaching of reading, perhaps at the pre-school level. He added that screening students' A-V integration skills prior to teaching reading might provide an additional index of readiness for reading. While it is unrealistic to expect teachers to assess learning-disabled children with A-V cross-modal matching tasks or formal tests of field-dependence-independence, it is reasonable to expect teachers to be sensitive to possible individual differences in perceptual styles and modality preferences. Specifically, teachers may well observe and note children's selection and organization of stimuli in a learning situation, and their modes and speed of decision-making and response. Such characteristics are definitely interrelated with the learning task. Assessment of how a child approaches and attempts to solve a learning task, the kind of information he uses, how he organizes it, which modality he prefers to use, his attention span and his anxiety level when he faces a problem-solving situation, may provide critical information for development of remedial programs. Field-dependence-independence and cross-modal matching ability appear promising constructs in broadening the range of factors of individual difference which is considered important in the educational setting.

The present study is limited in several respects. Only children from grade four and five were included, and these were of predominantly middle-class background as discussed previously. Future studies should include a much wider age range and populations that are more heterogeneous with respect to social-cultural background. Furthermore, this study could have been improved by using several test measures for each construct. For example, such tests as the Rod-and-Frame-Test and Human Figure Drawing Test could be used to assess field-dependence-independence .

Summary

This study was designed to investigate the relationships among cognitive style, cross-modal transfer and reading ability. The two broad questions to be answered were:

1. Will retarded readers show inferior performance in A-V, V-A integration tasks than normal readers?

2. Will cognitive style affect the performance in an A-V and V-A integration task? That is, will field-dependent children show deficiencies in visual-auditory and auditory-visual matching ability?

The following hypotheses were set forth for investigation.

Hypothesis 1. Retarded readers will score lower on auditory-visual cross-modal tasks than normal readers.

Hypothesis 2. Field-dependent readers will score lower in auditory-visual, visual-auditory cross-modal tasks than field-independent readers.

Hypothesis 3. The effect of interaction between cognitive style and reading level will be significant.

Two cross-modal tasks (A-V and V-A) were presented individually to each of 18 retarded readers and an equal number of control subjects. Both groups were subdivided at the mean criterion score of the Children's Embedded Figure Test into a Field-dependent and Field-Independent subgroup.

The results supported Hypothesis 1 and partially supported Hypothesis 2, but did not support Hypothesis 3.

Findings from the present study offer support for the Hypothesis of Birch and Belmont (1964) that the ability to make accurate A-V judgments is one specific psychological factor underlying learning to read. The fact that quite a number of children who are retarded in reading did poorly on the A-V and V-A cross-modal tasks suggests that the ability to match between auditory/visual modality and visual/auditory modality may be one of the several factors that contribute to successful reading.

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APPENDICES

APPENDIX A

CONTROL VARIABLES AND SCREENING DATA

Control Variables and Screening Data

Retarded Readers						Control Subjects					
S No.	C.A.*	Stanford IQ	Reading Grade**	CEFT	Sex	S No.	C.A.*	Stanford IQ	Reading Grade**	CEFT	Sex
R 1	131	108	3.4(5)	19	M	C 1	125	105	5.4(5)	24	F
R 2	115	105	2.7(4)	17	M	C 2	118	116	5.3(4)	19	M
R 3	113	119	2.9(4)	17	M	C 3	132	118	6.8(5)	23	M
R 4	123	114	3.6(5)	17	F	C 4	130	107	5.4(5)	22	M
R 5	128	119	3.5(5)	18	F	C 5	131	120	6.4(5)	20	F
R 6	113	110	2.7(4)	17	M	C 6	134	112	6.2(5)	24	M
R 7	114	100	1.8(4)	17	F	C 7	120	109	4.8(4)	23	M
R 8	117	106	2.8(4)	19	M	C 8	129	113	5.7(5)	24	F
R 9	116	103	2.7(4)	17	M	C 9	122	108	5.6(4)	23	M
R10	129	103	3.4(5)	10	F	C10	122	105	4.0(4)	11	F
R11	124	118	2.9(5)	14	M	C11	122	110	5.0(4)	14	F
R12	130	114	3.8(5)	14	M	C12	112	108	4.8(4)	10	M
R13	112	100	1.6(4)	11	F	C13	133	118	6.8(5)	16	F
R14	117	103	2.8(4)	11	F	C14	131	103	5.4(5)	15	F
R15	128	117	2.8(5)	12	M	C15	113	110	4.8(4)	15	M
R16	124	100	3.4(5)	11	F	C16	120	105	5.0(4)	16	F
R17	114	102	2.8(4)	15	M	C17	122	101	5.0(4)	16	M
R18	117	117	2.4(4)	15	F	C18	119	116	5.0(4)	16	F
$\bar{X}$ =	120.278	108.78	2.9	15.056		$\bar{X}$ =	124.167	110.22	5.41	18.389	
SD =	6.737	7.22	.58	2.96		SD =	6.767	5.61	.74	4.63	

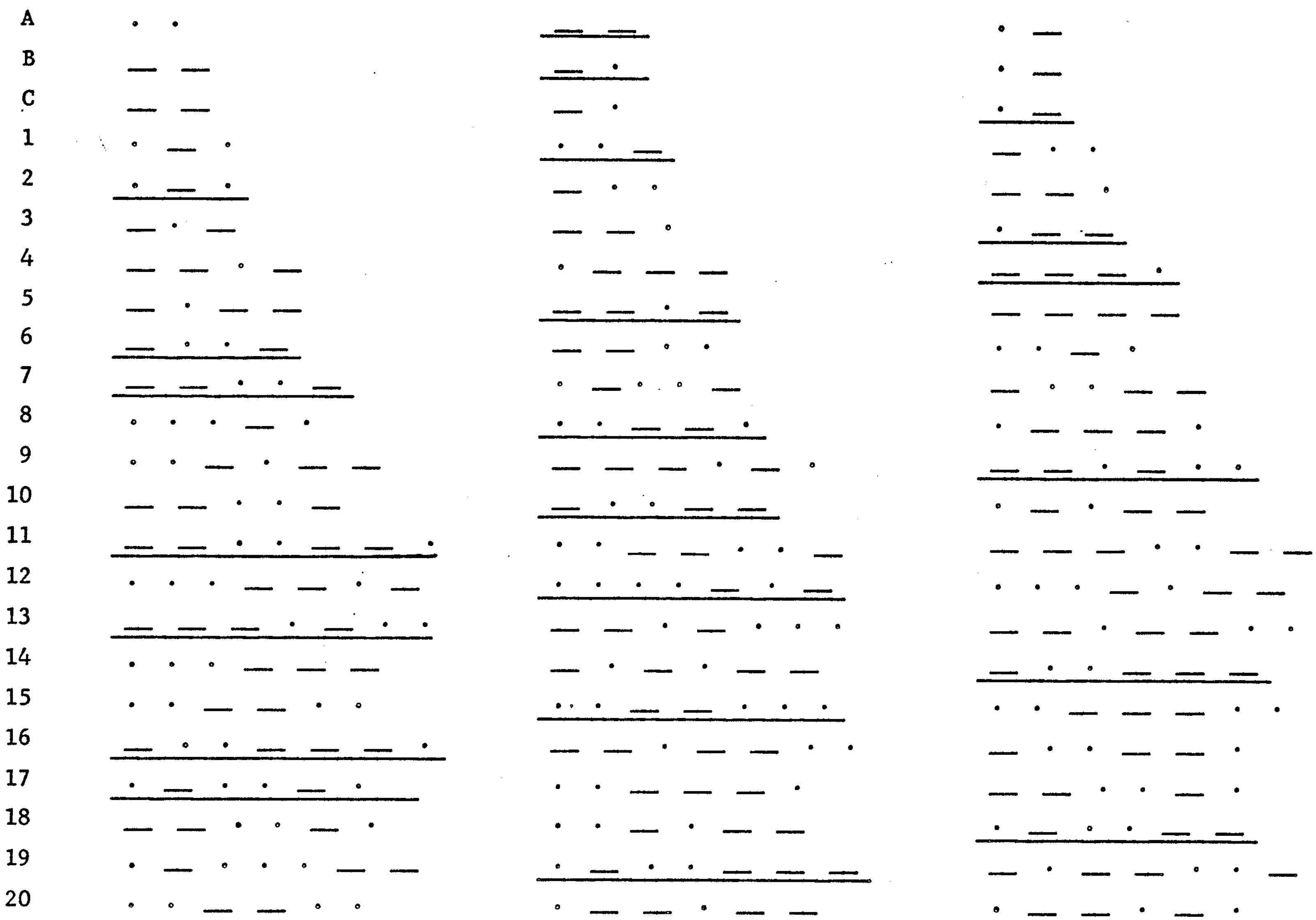
*Chronological age given in months.

**The number in the bracket is actual grade placement.

APPENDIX B

STIMULUS PATTERNS

Stimulus Patterns A-V Form



Stimulus Patterns V-A Form

	Standard Stimuli		Auditory Alternatives
A	• •	• •	• —
B	• —	— —	• —
C	— —	— —	— •
1	• — •	• — •	— • •
2	— • •	— — •	— • •
3	— — •	— • —	— — •
4	• — — —	— — • —	• — — —
5	— • — —	— • — —	— — — —
6	• • — •	— — • •	• • — •
7	— • • — —	• — • • —	— • • — —
8	• • • — •	• • • — •	• — — — •
9	— — — • — •	• • — • — —	— — — • — •
10	— — • • —	— — • • —	• — • — —
11	— — — • • — —	• • — — • • —	— — — • • — —
12	• • • — — • —	• • • — — • —	• • • — • —
13	— — • — • • •	— — • — • • •	— — • — — • •
14	— • — • — —	• • • — — —	— • — • — —
15	• • — — — • •	• • — — • •	• • — — — • •
16	— • • — — •	— — • — — • •	— • • — — •
17	• • — — — •	• • — — — •	— — • • — •
18	• • — • — —	— — • • — •	• • — • — —
19	• — • • • — —	— — • • — •	• • — • — —
20	• — — • — —	• • — — • •	• — — • — —

APPENDIX C

RAW SCORES OF A-V, V-A TASK

Raw Scores of A-V, V-A task

Retarded Readers			Control Subjects		
S No.	A-V	V-A	S No.	A-V	V-A
R 1	14	19	C 1	15	20
R 2	12	12	C 2	14	17
R 3	16	19	C 3	19	20
R 4	15	17	C 4	16	20
R 5	9	13	C 5	18	13
R 6	9	11	C 6	14	20
R 7	13	10	C 7	15	20
R 8	12	13	C 8	16	19
R 9	10	18	C 9	12	14
R10	9	16	C10	13	14
R11	9	13	C11	11	18
R12	8	16	C12	6	19
R13	6	9	C13	16	18
R14	13	17	C14	13	16
R15	2	16	C15	16	17
R16	12	17	C16	15	16
R17	13	15	C17	14	18
R18	13	11	C18	10	16

*Scores are number of correct trials.