4-1980

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STATE-TRAIT ANXIETY AND INCIDENTAL LEARNING OF SHAPES AND COLORS IN LEARNING DISABLED ADOLESCENTS

BY

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A THESIS
SUBMITTED TO THE GRADUATE FACULTY
OF THE UNIVERSITY OF RICHMOND
IN CANDIDACY
FOR THE DEGREE OF
MASTER OF ARTS
IN PSYCHOLOGY

APRIL, 1980

RUNNING HEAD: INCIDENTAL LEARNING

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ACKNOWLEDGEMENTS

I would like to thank all persons who contributed to the development and completion of this research. Much gratitude is extended to Mrs. Julia Ann Greenwood, Mr. Paul Foltz, and to the faculty, staff and students of the New Community School who gave so freely of their time and patience.

I would also like to thank the members of my most constructive thesis committee, Dr. James Tromater and Mrs. Jean Dickinson. Special appreciation is extended to the Chairperson of the committee, Dr. Kenneth Blick, without whose support, patience and understanding, completion of this research may not have been possible.

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ABSTRACT

The present study attempted to examine the effects of anxiety on incidental learning of colors and shapes. The central task was the learning of six CVC syllables with meaningfulness association values between 2.41 and 2.49. The incidental task was the learning of the color or shape that the syllable was printed on. The subjects were thirty-four male and female adolescents identified as learning disabled. The subjects were divided into three anxiety groups (high, medium and low) using Spielberger's State-Trait Anxiety Inventory. The results indicated that anxiety (state or trait) had no significant effect on incidental learning in adolescent subjects. The results may have been effected by the simplicity of the task.

State-Trait Anxiety and Incidental Learning of Shapes and Colors in Learning Disabled Adolescents

The process of acquiring information which is not task relevant as designated by the experimenter is called incidental learning. A possible explanation for incidental learning is Broadbent's (1958) filter theory. In his theory, Broadbent suggests that an individual is limited in the amount of information he can process at any given time. When information input exceeds this limit, the part of the information selected for processing is task-relevant stimuli. If a task is over learned or simplified, incidental learning is more likely to occur because selective attention may not be necessary for effective task performance and the limit for information intake is not exceeded.

Using various methods, investigations into incidental learning have indicated a curvilinear relationship between incidental learning and age. That is, there seems to be a developmental trend in incidental learning. Research indicates that incidental learning increases from preschool to about age eleven and then undergoes a decline. Stevenson (1954) with subjects aged three to seven years examined in-

cidental learning using a V-shaped maze. Children were motivated to find a toy in a locked box. The key was located in a separate box with other objects. Incidental learning was tested by the subjects' recall of objects in the box with the key. Stevenson found that the ability to locate test objects showed incidental learning and this learning increased with age. Crane and Ross (1967) compared the incidental learning of second- and sixth-graders in order to ascertain whether there are developmental trends in this mode of attending. Their procedure required visual discrimination between forms and colors. Color was made the relevant dimension first. After this learning, form (the irrelevant dimension) was paired with color and consistantly presented until learned. Subjects were then given trials which used the irrelevant dimension of form as the relevant dimension as a test of incidental learning. Crane and Ross found that the younger subjects profitted more from the third phase, that is recalling form as opposed to color, of the experiment than did the older subjects when the irrelevant material became relevant to task completion. Maccoby and Hagen (1965) used first-, third-, fifth-, and seventh-graders in a visual learning task. Their task consisted of using colors with simple line drawings (incidental stimuli). The subjects were asked to identify a particular color card

for the central task. Incidental learning was measured by the ability to locate certain line drawings with specific colors. This study found that incidental learning increases regularly with age. Hagen (1967) using subjects in grades one, three, five, and seven, gave a task containing pairs of contiguous figures, one an animal and the other a household object. Incidental learning was measured by having the subjects recall the member of the pair which he was not instructed to learn. It was found that learning of task relevant material increased regularly with age. Siegal and Stevenson (1966) with subjects ranging in age from seven to fourteen years, employed a three-choice successive discrimination task involving the task relevant object being paired with three irrelevant objects in the stimulus complex. Incidental learning was measured by the number of times subjects made responses to the incidental objects that had been correct for the stimulus complex in which they had been imbedded. The study showed a significant increase in incidental learning between ages seven and eight and eleven and twelve, and a subsequent significant decrease between ages eleven-twelve and thirteen-fourteen. Siegal (1968) using three-choice successive discrimination tasks with eight and fourteen year olds found that incidental learning was lower in the older group of children.

Several reasons have been proposed for the decline of incidental learning with increasing age. Maccoby and Hagen (1965) suggest the possibility that younger children are just learning to categorize, code, and label object-processes which probably make it possible to take note of several things at once. This stage is followed by a period of development of the ability to shut out undesired stimuli, hence a decline in incidental learning giving the effect of a curvilinear relationship between learning and age. Druker and Hagen (1969) suggest that developmental changes responsible for selective information processing don't involve improved visual discrimination. They imply that older children are characterized by more efficient encoding and rehearsal strategies, thus leading to better processing of selective information. Siegal and Stevenson (1966) note that the increase in amount of incidental learning in younger subjects may be due to either an increasing ability to learn and retain or an increasing tendency to attend to irrelevant stimuli. In older subjects the decline in the amount of incidental learning may be due to the tendency of older children to disregard the irrelevant stimuli. Siegal (1968) proposed reasons similar to those of Siegal and Stevenson.

Anderson, Holcomb, and Doyle (1973) studied incidental learning in learning disabled children. Normal and learning disabled children performed a vigilance task where they were seated in a booth before a console containing a line drawing. The central task was to indicate, by pressing a button, when lights flashed across the console to make a red-green combination. Normal subjects were found to perform better on the vigilance task while the learning disabled subjects experienced difficulty in attending to the task and responded more to extraneous stimuli. Hallahan, Kaufman and Ball (1973) employed the Hagen (1967) attention-retention task of contiguous figure pairs. Their subjects were sixth-grade males classified as learning disabled and normal. They found that normal children were better central task attenders than the learning disabled children. Mercer, Cullinan, Hallahan, and LaFleur (1975) selected 20 boys aged from nine to fourteen from a population of learning disabled children and studied modeling and attention-retention behavior. The Hagen (1967) task was used for the attention-retention task to test the level of incidental learning. Subjects were then shown a video-tape of the behaviors which they were to model when the film was finished. Subjects' scores on modeling behavior were then compared to their scores on the attention-retention task. Those subjects scoring

high on the Hagen central task were also good modelers. Those scoring low on the Hagen central task had low modeling scores. These results suggest that modeling behavior is related to attention-retention of relevant information.

There is research which has indicated a relationship between incidental learning and anxiety. Esterbrook (1959), before anxiety research experienced its "boom", referred to anxiety as a high drive state. In his research he suggested that high drive levels limit a person's perceptual field, thus reducing not only central task but also incidental task learning. Sarason (1973) also found similar results with incidental learning and anxiety. Wine (1971), in a review of the literature, suggested that high test anxious persons divide their attention between self-relevant and task-relevant variables while low test anxious persons focus more fully on task. Anxiety was noted to reduce the range of task cues utilized in performance of a given task. In support of Wine's (1971) attentional theory, research by Liebert and Morris (1970) using high school and college students, their physiological measures and Sarason's Test Anxiety Questionaire (worry and emotionality items) during examinations found that the amount of worry, a component of of anxiety, effected examination grades. The relationship showed a negative correlation. They suggest that high anxi-

ous subjects divide their attention between task-relevant stimuli and self-stimuli. Dusek, Mergler and Kermis (1976) examined the effects of anxiety on incidental learning in children. Using a modification of the Hagen (1967) central-incidental learning task, they tested high-test anxious and low-test anxious (test anxiety being a situational or state characteristic) second-, fourth-, and sixth-graders. They found that low-test anxious subjects performed better on the central learning task than did the high-test anxious subjects. Although grade level x anxiety did not show any significant effects on incidental learning (indicating no age differences), incidental learning scores revealed significant differences due to anxiety level alone. Incidental recall was higher for high-test anxious than for low-test anxious subjects. These results again reinforce the theory that high-test anxious subjects have an attentional focusing problem.

Color as opposed to form has also been studied, to some extent, in relation to incidental learning. Bernstein (1971) examined color as opposed to form in seven versus twelve year old boys. The color was either inside or outside the forms (simple animal drawings). The central task was to tell whether the animals were real or make believe. A difference between incidental and intentional learning was found under the color-in condition. There was

no significant difference between intentional versus incidental learning in the color-out condition. Also older childrens' learning was superior to younger childrens' learning. Judgemeyer (1971) studied the effect of color and complexity of form upon paired-associative learning. This was done in an effort to determine which mode of presentation offered the best opportunity for efficient learning in high versus low achievers in grades three, six, nine, and twelve. Judgemeyer found that color and/or complexity of form did not effect learning.

Higher incidental learning has been found in younger as opposed to older subjects (Stevenson, 1954; Crane and Ross, 1967; Hagen, 1967; Maccoby and Hagen, 1965; and Siegal and Stevenson, 1968) and in learning disabled as opposed to normal subjects (Anderson, Holcomb, and Doyle, 1973; Hallahan, Kaufman, and Ball, 1973; Mercer, Cullinan, Hallahan and LaFleur, 1975). Incidental learning has also been shown to be effected by anxiety (Esterbrook, 1959; Wine, 1971; Sarason, 1973; and Dusek, Mergler and Kermis, 1976) being higher in high anxious subjects. Color and form have also been shown to be related to incidental learning (Bernstein, 1971; and Judgemeyer, 1971). In the present study incidental learning of color and geometric shapes was examined in relation to anxiety in learning disabled adolescents. The

following study will examine trait and state anxiety as opposed to test anxiety to obtain an overall as well as a state measure, and geometric shapes as opposed to object form and their relation to incidental learning. Adolescent subjects were used in this study because eariler studies (Maccoby and Hagen 1965; Siegal and Stevenson, 1966; and Hagen, 1967) have indicated incidental learning has reached a "plateau" at this age. If factors relevant to increasing chronological age offer explanations for lowered incidental learning, these factors may also provide information if there are differences in incidental learning in high- and low- anxious subjects.

In the present study, it was hypothesized that high-anxious subjects (state or trait) would show more incidental learning than low-anxious subjects and that high-anxious subjects would use more trials for central task learning. Also incidental learning of color and shape was examined to determine if there was a difference in their use as incidental material for high- and low-anxious subjects.

Postman (1964) has suggested two procedures for testing incidental learning. Type I is a situation in which the subject is not instructed to learn any specific aspect of the exposed materials but is tested on the materials presented. Type II is a situation in which the subject is instruc-

ted to learn a specific characteristic of the presented materials and is also exposed to stimuli not referred to in the instructions for the central task. In this situation, incidental learning is measured by the subjects' recall of this irrelevant material. Most research testing incidental learning used the Type II Paradigm (Maccoby and Hagen, 1965; Hagen,1967; Stevenson and Siegal, 1966; Bernstein, 1971; and Dusek, Mergler and Kermis, 1976). The Type II Paradigm was also used in the present study.

METHOD

Subjects: Subjects were 34 adolescents, 28 males and 6 females, who attended a private community school for learning disabled adolescents. They ranged in age from 12 to 19 years. Letters requesting permission (see Appendix A) for subjects to participate in the research and explaining its purpose were sent to the parents of each prospective subject.

Apparatus and Materials: Originally a set of eight presentation cards were to be used but problems in length of test sessions were encountered with the first four subjects and with committee approval, the number of presentation cards was reduced to six.

Three color cards (red, green and blue) each measuring 4" square and three cards in geometric shapes (circle, rec-

tangle and triangle) were used. Each of the six cards had a CVC syllable printed in the center in cursive writing. There was also a set of color and shape cards like the aforementioned cards without the words. The syllables were chosen from the Noble (1961) list of 2100 CVC combinations with association values between 2.41 and 2.49. The card pairings were: Red-vul; blue-fum; green-tig; circle-dob; triangle-cak; and rectangle-wep. As a measure of state and trait anxiety, the Spielberger State-Trait Anxiety Inventory (STAI) was used. A cardboard back approximately 3½" square was attatched to a 5" base forming a shelf allowing the presentation cards to stand. This apparatus insured uniform presentation of the stimulus cards.

Procedure: At the beginning of each individual testing session, the student was given the state section of the STAI. The student was instructed to follow along and read the directions and statements silently as the examiner read them aloud, allowing sufficient time for the subject to respond to each statement. The subject was told that the tasks to follow would be memory games.

The students were told that they would see six nonsense syllables printed in cursive on separate cards and were instructed to remember the syllables for the central learning task.

In the test trials, one trial consisted of the presentation of the six syllables in random order for five seconds each. Presentation time for each card was timed by a stopwatch, and each card was removed from the subject's sight before the next card was presented. The procedure gave the subject equal exposure to central and incidental material regardless to central task performance.

After presentation of the six cards, the subject was asked to write the syllables he remembered on a numbered sheet having 30 seconds to do so. When the thirty seconds were up the sheet was removed and this procedure was repeated until the subject made two consecutive errorless trials.

After completing the central learning task, the subject was then tested on the incidental learning task. The subject was exposed to the full array of color and shape cards without words. He was then presented with a flash card with one of the syllables printed on it in cursive. He was to point to the color or shape in the display in front of him on which the word appeared. Each time the subject was asked to match a syllable with its color or shape he chose from the entire set of cards. The number of correct matches out of the six trials was the measure of incidental learning.

At the end of the test trials, the subject was asked to complete the Trait section of the STAI. The subject was

instructed to follow along and read the directions and statements silently as the examiner read them aloud, allowing time for the subject to respond to each statement.

RESULTS

The subjects were divided into high, medium, and low anxiety groups according to STAI scores. A simple independent-groups analysis of variance showed significant differences between group divisions for state and trait anxiety, $F(2,27)= 109.99$, $p < .05$ and $F(2,27)= 46.46$, $p < .05$, respectively. A Newman-Keuls' multiple-range test on the means for state and trait divisions found significant differences between the groups for both state and trait group divisions.

To determine whether state and trait anxiety were related measures, a Pearson product-moment correlation showed a significant relationship between the state and trait measures of the STAI ($r= .58$, $p < .05$). In analyzing trials to criterion and incidental learning (collapsed across color and form), a Pearson product-moment correlation showed no significant relationship between trials to criterion and incidental learning ($r= -.11$, $p > .05$). Using a simple analysis of variance to analyze trials to criterion and levels of anxiety, there were no significant differences found between trait anxiety and trials to criterion, $F(2,27)= < 1$,

$p > .05$. A similar analysis for state anxiety also showed no significant differences, $F(2,27) = 1.32$, $p > .05$.

In the next analysis, level of trait anxiety and type of incidental learning task were the independent variables, while the dependent variable was the number of correct responses to incidental material out of a total of six. No significant interaction was found between levels of trait anxiety and type of incidental learning, $F(2,27) = < 1$, $p > .05$, using a 3 x 2 repeated-measures analysis of variance. Analysis of the main effect of trait anxiety produced non-significant results, $F(2,27) = 2.24$, $p > .05$. The main effect between color and shape was also not significant, $F(2,27) = 2.52$, $p > .05$. The data for this design are shown in Table 1.

Insert Table 1 about here

A significant interaction was found between levels of state anxiety and type of incidental learning task, $F(2,27) = 3.65$, $p < .05$, using a 3 x 2 repeated-measures analysis of variance. However, an examination of all possible simple effects failed to produce any significant differences. The data for this design are shown in table 2.

Insert Table 2 about here

DISCUSSION

A significant correlation of .58 was found between STAI trait and state anxiety scales in accordance with reports by Speilberger (1970) of a correlational range of .44 to .67. There was no correlation found between trails to criterion and incidental learning. The non-significant correlation suggests that the number of trials a subject used to learn the central material had no effect of the amount of incidental mateial acquired. There were also no significant differences found between trials to criterion and levels of anxiety (state or trait). This non-significance suggests that the number of trials a subject used to complete the central learning task was not affected by how anxious that subject was. That is, the variability in the number of trials used to learn the central task was so widespread that no predictions could be made for differences according to whether the subject was high-, medium-, or low-anxious.

Although significant differences in incidental learning in relation to anxiety levels were hypothesized, no significant differences were found. These results suggest that as has been stated by Hagen (1967), Maccoby and Hagen (1965), and Seigal and Stevenson (1968), incidental learning has reached its "plateau" in adolescent subjects. In these

studies using Hagen's (1967) or modified versions of Hagen's task, the experimenters found age differences in amount of incidental learning. Younger subjects recalled more incidental material while older subjects were better central task learners. Older subjects were found to be better at selecting, encoding, and processing task relevant information than were younger subjects.

The basis for the hypothesis of the present study came out of a study by Dusek, Mergler, and Kermis (1976). They found that high test-anxious students, as opposed to low test-anxious students, showed higher incidental learning using a modification of the Hagen (1967) central-incidental learning task of contiguous figures. They also found that grade level x incidental learning showed no significant effects on incidental learning (indicating no age differences). Incidental learning scores revealed significant differences due to anxiety alone. This study, however, used second-, fourth-, and sixth-graders, whereas the present study used seventh- through twelth-graders. With the older subjects, the more mature processing techniques of the central material may have lead to less interference of the incidental material.

A study by Liebert and Morris (1970) was also a factor in the present hypothesis as they used high school and col-

lege students with Sarason's Test Anxiety Questionaire (worry and emotionality items). They found that during examinations the amount of worry, a component of anxiety, affected exam grades. They suggest that high-anxious subjects divide their attention between task relevant stimuli and self-stimuli. In the present study, rather than focusing attention on incidental material when central task was not attended to, aspects of self may have been a factor.

A third basis for the present hypothesis was that of Hallahan, Kaufman and Ball (1973) whose study compared learning disabled to normal subjects. Using the Hagen (1967) task with sixth-grade subjects, they found that normal subjects were significantly better at attending to the central task than learning disabled subjects. The differences may be due to a developmental lag experienced by learning disabled students in relation to normal students (Hallahan and Kaufman, 1976). However, this lag may be caught up by adolescence which could, possibly, explain non-significant results of the present study.

With learning disabled subjects being so variable in several characteristics, future research may have to rely on stricter control over these variables or inclusion of them in research. Variables such as skill in and use of mnemonic devices and visual and auditory modes of learning

are among those to be controlled for or included. In the particular area of the present study, future research may include looking at the role that meaningfulness of material plays in research with learning disabled children. Also future research may include looking at behavioral differences in anxiety levels between normal and learning disabled subjects.

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Table 1

Design for trait anxiety with means and standard deviations for each group.

TYPE OF INCIDENTAL LEARNING TASK

ANXIETY LEVELS	Shape	Color
High	$\bar{X}$= 2.0 s= .94	$\bar{X}$= 1.5 s= .71
Medium	$\bar{X}$= 2.0 s=1.15	$\bar{X}$= 1.6 s= .97
Low	$\bar{X}$= 1.2 s= .79	$\bar{X}$= 1.1 s= 1.1

Table 2

Design for state anxiety with means and standard deviations for each group.

ANXIETY LEVELS	TYPE OF INCIDENTAL LEARNING TASK: Shape	TYPE OF INCIDENTAL LEARNING TASK: Color
High	$\bar{X}$= 1.7 s= .95	$\bar{X}$= 1.7 s= .95
Medium	$\bar{X}$= 1.6 s=1.03	$\bar{X}$= 1.3 s=1.05
Low	$\bar{X}$= 1.7 s=1.16	$\bar{X}$= 1.1 s= .73

Appendix A: Consent Form

CONSENT FORM

I give permission for _____ to participate
(first) (last)
in a research project involving learning tasks with nonsense syllables paired with colors and geometric shapes. The purpose of the research is to study incidental learning as it relates to levels of anxiety. I also give permission for him/her to take an anxiety inventory, which will be taken anonymously. This measure of anxiety is a paper and pencil test, the scores of which will not be released to the subjects, clearly causing no risk to participants. The scores and responses to the learning tasks will be confidential with only the researcher, LaDonna Cabell, and her supervisor, Dr. Kenneth Blick, receiving the information. My child will be free to terminate his/her participation in the research at any time.

(Signed) _____

(Date) _____

Appendix B: Debriefing Interview

The following format was used in the debriefing interview.

1. Explanation of research.
2. I will inform you about the results of the research at its completion.
3. Please do not discuss this experiment with your peers.

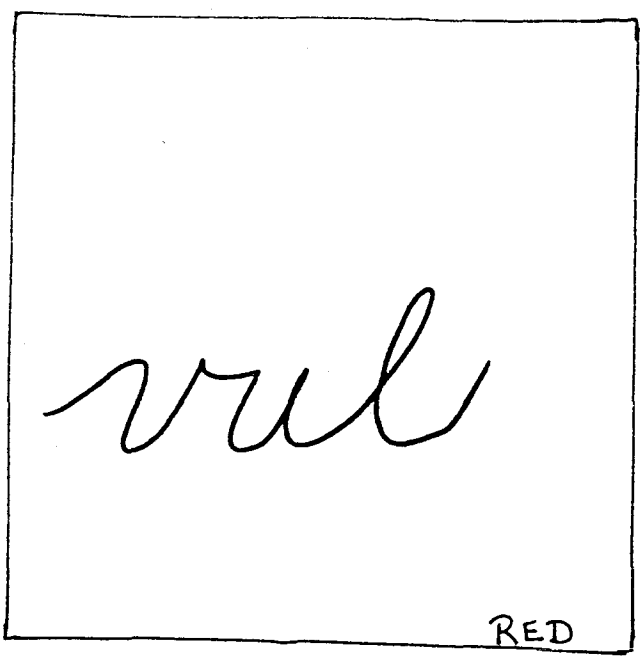
Appendix C: Individual Data

Subjects	Sex	A-State	A-Trait	Trials To Criterion	Total Incidental Learning	Shape	Color
1	M	34	34	5	2	0	2
2	M	27	35	17	0	0	0
3	F	49	52	13	2	1	1
4	M	52	59	4	6	3	3
5	M	41	36	17	0	0	0
6	M	31	26	9	3	2	1
7	M	44	54	10	5	3	2
8	F	39	39	4	4	2	2
9	M	49	44	16	4	2	2
10	M	39	32	18	2	2	0
11	M	33	33	12	2	2	0
12	M	56	35	9	1	1	0
13	M	32	36	16	5	3	2
14	M	43	47	6	3	2	1
15	F	54	42	4	2	1	1
16	F	26	26	19	3	1	2
17	M	30	42	25	4	3	1
18	M	27	39	8	4	3	1
19	F	48	51	12	2	1	1
20	F	40	33	7	4	1	3
21	M	38	41	18	2	1	1

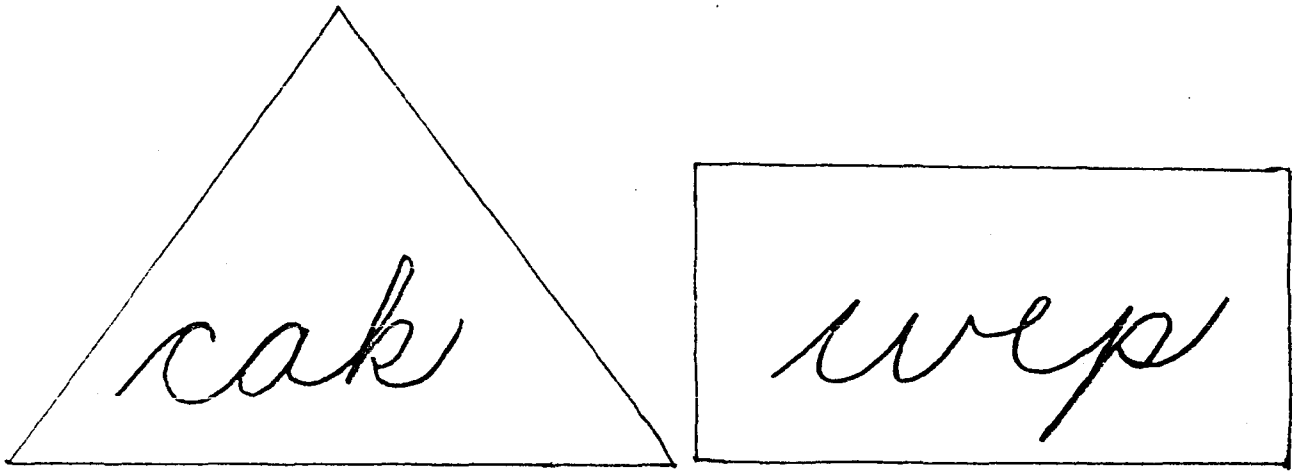
Appendix C: cont.

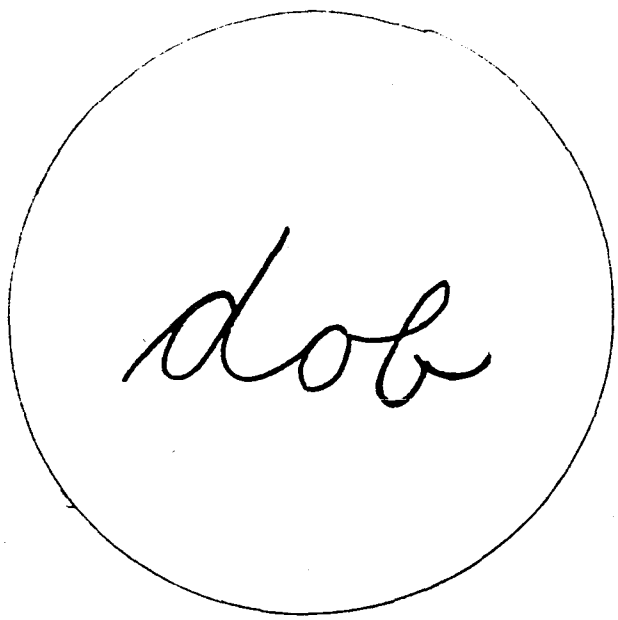
Subjects	Sex	A-State	A-Trait	Trials To Criterion	Total Incidental Learning	Shape	Color
22	M	33	29	8	4	2	2
23	M	38	41	4	2	1	1
24	M	27	34	23	2	1	1
25	M	50	39	11	3	1	2
26	M	42	48	2	4	3	1
27	M	56	55	5	3	1	2
28	M	36	41	26	6	3	3
29	M	40	38	12	4	3	1
30	M	47	42	11	6	3	3

Appendix D: Central-Incidental Material (Color)



Appendix D: cont. Central-Incidental Material (Shape)





VITA

I was born and raised in Lynchburg, Virginia on October 24, 1953. I attended Hampton Institute in Hampton, Virginia and graduated with a B. A. in Psychology, in 1976. I taught remedial reading and math in elementary school for two years after my graduation. My future plans include a career in psycho-educational consulting.