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VARIABLES AFFECTING THE PERFORMANCE OF YOUNG CHILDREN ON A LETTER DISCRIMINATION TASK.

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THE PURPOSE OF THIS STUDY WAS TO DETERMINE THE RELATIVE INFLUENCE OF FIVE VARIABLES (INITIAL INSTRUCTIONS, REWARD, LETTER SIZE, TYPE OF WARM-UP, AND FEEDBACK) ON KINDERGARTEN CHILDREN'S PERFORMANCE OF A LETTER DISCRIMINATION TASK. IT HAS BEEN ARGUED THAT ATTENTION IS THE KEY FACTOR IN LETTER DISCRIMINATION. THE PRESENT STUDY PROPOSES THAT A PRECONDITION TO SUCCESS BY CHILDREN IN LETTER DISCRIMINATION IS HAVING AN ADEQUATE CONCEPT OF "SAMENESS." THAT IS, IF THE CHILD IS NOT AWARE OF WHAT THE EXPERIMENTER MEANS BY THE WORDS "SAME" AND "DIFFERENT" IN A DISCRIMINATION TASK, ATTENTION IS ALMOST IRRELEVANT. EIGHTY KINDERGARTEN PUPILS WERE DIVIDED INTO FIVE TEST CONDITIONS TO PERFORM THE DISCRIMINATION TASK. THE TASK METHODOLOGY CONSISTED OF PRESENTING A SINGLE LETTER ON THE LEFT SIDE OF A PIECE OF PAPER AND FOUR ROWS OF TEN LETTERS ON THE RIGHT SIDE. AMONG THESE 40 LETTERS WERE FIVE LETTERS IDENTICAL TO THE SINGLE LETTER, FIVE MOST LIKELY TO BE CONFUSED WITH THE SINGLE LETTER, AND 30 ADDITIONAL LETTERS. THE CHILD WAS ASKED TO IDENTIFY THE LETTERS IN THE FOUR ROWS THAT MATCHED THE SINGLE LETTER. THIS METHOD REPRESENTED TEST CONDITION ONE. THE REMAINING FOUR CONDITIONS WERE ESSENTIALLY THE SAME AS CONDITION ONE EXCEPT FOR VARIATIONS IN SCORING INSTRUCTION GIVEN (CONDITION TWO), USE OF REWARD (CONDITIONS THREE AND FIVE), AND TYPE OF WARM-UP (CONDITION FOUR). THE RESULTS SHOWED THAT NEITHER VARIATION OF LETTER SIZE NOR SCORING INSTRUCTIONS HAD AN EFFECT ON PUPIL PERFORMANCE. THE FEEDBACK WAS EFFECTIVE, FOR IT HELPED THE PUPIL DEVELOP THE CONCEPT OF "SAMENESS" NECESSARY TO MAKE THE DISCRIMINATION. (WD)

VARIABLES AFFECTING THE PERFORMANCE OF YOUNG CHILDREN ON A LETTER DISCRIMINATION TASK

by

Vernon C. Hall, Edward Caldwell and Gwen Simpson

Several studies (Davidson, 1935; Smith, 1928; Wilson and Flemming, 1938) have indicated that reversal errors in letter discrimination persist until at least seven years of age. Hildreth (1932) and Ilg and Ames (1950) have also shown that in copying, reversal errors were present until at least seven years of age. Vernon (1960) in reviewing these studies suggested, "This development seemed to be due to maturation rather than to learning to read, for Hildreth found that among the children he studied those who had begun to read showed little superiority to those who had not." Most of these studies tend to imply or state that reversal errors result from an inability to perceive the distinction between letters because of a lack of neural maturation.

Hendrickson and Muehl (1962) took exception to this normative data. "Do the norms reported on the left-right inversions mean that preschool and early school-aged children: (a) literally cannot 'see' the difference between two figures so inverted, or (b) lack the instructional set to realize that this kind of difference is important?" Their study furnishes evidence that preschool and early school children are not deficient in perceiving a difference when, by use of a motor response, attention is directed toward the left-right differences. While the authors speak of "a set to realize that this kind of difference is important" which is operationally equivalent to learning an appropriate concept of "same" and "different", they interpret their results entirely in terms of attention to the stimuli. They feel that the significant factor in the motor response is in getting the S to pay attention to the left and right curves on the d and b. While there can be no doubt that attention is a necessary condition for the discrimination task, it is argued here that it is not a sufficient

condition. Discrimination tasks which involve judgments of "same" or "different" require as a prerequisite an adequate concept of "sameness". While the earlier studies cited may be interpreted in light of Hendrickson and Muehl's concern with attention, they may also be interpreted as instances of concept testing. When a subject is faced with the task of discriminating between b and d etc., it may well be that his performance does not at all reflect his ability to discriminate between graphemes but is merely a measure of his concept of "same" and "different" as applied to the world of two-dimensional objects. (Typically he has had no previous training for this task in the two-dimensional world and hence applies the laws he has learned from the three-dimensional world.) Money (1966) says it well:

> The prereader lives like a spy in a jungle of camouflage learning during all the years of his preschool experience that objects retain their same identity and meaning irrespective of transformations and disguise. Without changing its name or significance, an object may take on a different visual form by rotation to any point of a compass, fall upside down, may recede into the distance, or approach. It may be dismembered, disassembled, or subtracted from. It may be embellished and added to. Or its salient characteristics may change, as in the many species of dogs or types of chairs. Nonetheless, despite any of these possible changes, the object has the same designation and meaning. It obeys the law of object constancy. Learning to read turns the prereaders' conceptual world of object constancy into chaos, for it supplements and supplants the law of object constancy with the law of directional constancy and the law of form constancy.

Hence young children typically do not perform well on letter discrimination tasks, since they are likely to be applying inappropriate concepts of "same" and "different" in the testing situation.

While Hendrickson and Muehl interpreted their results in terms of an attentional factor, we would argue that their training procedures also employed a concept learning task. A bell which signaled a correct response for the two experimental groups learning the directional set served as feedback hence supplying S with information as to what E accepted as same and what must be considered as different in this special realm of two-dimensional objects. In

Money's terms, S was discovering the "law of directional constancy."

The purpose of the present study was to investigate the relative influence of five variables (initial instructions, reward, letter size, type of warm-up and feedback) on young children's performance on a letter cancellation task. The first two variables were viewed as elements of attention, while the latter two would be part of learning the concept of "same" as it applies to letters. The letter size variable was added to determine the validity of a widespread but seemingly untested assumption that young children cannot perceive differences in the size of type typically used on standard typewriters (i.e. pica).

The strategy of the present study was to replicate a widely quoted study of letter discrimination by Davidson (1935) which reported age norms on the acquisition of the ability to discriminate the letters d, b, q, and n (along with other letters). In addition each of the five conditions mentioned above would be varied to determine what effect they had on performance. Therefore, in order to explain the rationale behind the actual procedures used in defining the above conditions, it is necessary to briefly discuss the procedures and findings of the original Davidson study. This can best be done by quoting Davidson. "The Letter Perception Test devised for this experiment was in the nature of a cancellation test. A certain letter was printed in large black type at the left side of a sheet of paper. After it a 'box' was drawn containing four rows of ten letters each. Among these letters were five identical to the given letter, five of the letters most likely to be confused with it (the mirrored opposite in the case of d, q, and b), several each of other possibly confusing letters including several tall letters in case 'tallness' was an important factor in letter recognition, while the remainder were randomly selected letters. The children were instructed to look at the given letter, then find every one exactly like it in the box and mark it when they found it. There was one practice exercise (p. 459)."

When scoring the results Davidson explains that since some children did not mark all five of the letters "A child has been credited as having confused b and d whether he marked one b or five b's." (When the standard is d.) The results indicated that a chronological age of 5 and 1/2 was required for 50 percent of the subjects to correctly mark up down confusions and 7 and 1/2 years were needed before 50 percent correctly marked left right discriminations. Confusion persisted through 8 years of age for both types. This is consistent with Wilson and Flemming (1938) who found confusion persisting to the age of 8 or 9 years.

One strategy in taking a cancellation test is to mark all answers which might possibly be correct, thinking that some will be right with little attention given to details. On the other hand when the S is aware that some kind of correction procedure is being used (i.e., if one is wrong all are wrong) then the correct strategy would be to be more careful. Thus, in the present study one of the deviations from the original Davidson procedure was to instruct the children that one incorrect letter on a single row of letters made the entire row incorrect.

With regard to reward it was speculated by the experimenters that the group standardized testing situation in which there are no real incentives to perform well (i.e., the fact that it is an outside administrator telling them they won't be graded for their performance) may lead some children to not try very hard or attend adequately. Thus, it was hypothesized that if attention is important a tangible reward (candy) contingent on correct responses would be influencial in improving performance to the extent that it increased attention to the task.

The brief mention of a warm-up condition in the original study left us with somewhat of a problem. The experimenters felt this was an extremely crucial variable because if the child's definition of "same" is different from that of

the experimenter's a wrong answer will occur even if the child is perfectly capable of discriminating crucial differences. In the present experiment the warm up was designed to measure either a very global meaning of the word "same" (i.e., triangles and circles) or one in which orientation (right and left, up and down) of letter like forms was the distinguishing feature.

It has often been mentioned by reading experts that the size of the letter is important for young children. For instance, Bloomfield and Barnhart (1961) tell us "Under no circumstances should you start to teach your child to read until he has the necessary muscular skills to see the small distinctions between the letters of the alphabet. You can tell he has the necessary muscular coordination when you notice that he can button his clothes or see and pick up a pin on the floor (p. 3)." Although the actual size of the letters used by Davidson were not mentioned we had planned to use pica size type. When the principal of an elementary school listened to our research plan, he mentioned that this was much too small for kindergarten children and that all elementary schools had typewriters with primary size type. Therefore, we decided to use letter size as a variable. Half of the children received the task using pica type and half using primary type. If larger type was easier for the young children to see then obviously one would expect better performance on the primary type. The Es, however, having watched younger children of their own perceive much smaller differences in the natural environment predicted no differences in performance on the two sizes of type.

Finally, since the group receiving candy was to receive feedback on how well they did on the task (in order to determine how many candies they were to be rewarded) it was decided to see how important this feedback was for future performance. Therefore, on the day following the original presentation all children were re-administered the same task and everyone was told in advance

that he would receive 4 pieces of candy for doing a good job. The feedback from day one would thus serve to develop the appropriate concept of "same" for the Ss in the candy groups.

Subjects: Ss were 80 kindergarten students attending the Jamesville-Dewitt Elementary School, Jamesville, New York. Their chronological ages ranged from 5 years 5 months to 6 years 4 months with 60% being below 6 years of age. They were randomly assigned to one of five treatment groups as they entered the experimental room.

Methods and Procedure: Each child was brought individually into the experimental room and the appropriate instructions were read to him. After the instructions were read the experimenter left the presence of the S and returned only if the S had any questions or when the S had completed the task. The experimenters at no time deviated from the written script except to reiterate instructions or encourage the S to keep going. The warm up (Figure 1) required the S to complete only two lines and then he was shown how well he had done.

The actual design consisted of two letter sizes and the five following treatments: 1) Replication of the Davidson study but administered individually using circles and triangles for warm up (poor definition of same and low motivation to attend); 2) Same as condition 1 except the S is instructed that if he circles one letter incorrectly the entire line is incorrect (poor definition of same and moderate motivation to attend); 3) Same as condition 2 except that the S was presented with one M and M candy for each correct answer but if one is incorrect the S loses all candy won for that row (poor definition of same and high motivation to attend); 4) Same as condition 2 except that symbols with relevant cues for the final task were used in the warm up (good definition of same and moderate motivation to attend); 5) Same as condition 4 except that

M and M candy was used as in condition 3 (good definition of same and high motivation to attend).

Upon the completion of the task Ss in conditions 1, 2, and 4 were sent back to their classroom. Ss in conditions 3 and 5 were shown which items were correct and which were incorrect and rewarded their candy. No mention was made of why individual items were correct or incorrect. The next day all Ss completed the same task and were given four M and M candies.

Results: Table 1 gives a summary of the results as well as the results of the Davidson study for the same age group. A 2 (letter size) by 5 (treatment) analysis of variance on the first test was computed using percentage correct. The performance on letter size was almost identical (F .34, 4/70 df). Although the treatment effect was only significant at the .08 level (F 2.27, 4/70 df) examination of Table 1 shows that Ss in condition 5 outperformed all of the other conditions which were at a level equal to that of children with a C.A. of 7-6 to 7-11 in Davidson's sample on letters d and n, better than 7 year olds on the b and outperformed the 6-6 year olds on the q. Treatment 1 on the other hand yielded results almost identical to that of Davidson.

A 5 way analysis of covariance removing performance on the first test was then computed for the second test. The treatment effects were found to be significant (F 4.45, 4/70 df, P .05). In addition, a Scheffe analysis indicated that treatments 3 and 5 were significantly better than 2 and 4 as well as 1, 2, and 4. In addition, it should be noted that children in treatment 5 outperformed all ages used by Davidson (she included children up to 8 years of age).

Discussion: There is little doubt that the results of this experiment indicate that letter size is not an important factor with kindergartners. In all cases performance on both letter sizes was almost identical. In addition, the instruction given to the child with regard to scoring procedures had little

effect. The Es tend to think that kindergartners are not yet sophisticated enough test takers to apply different strategies when a correction procedure is used for wrong answers.

It is also clear from the findings that concept learning as we have defined it here is more important than the attention factor. When children are unaware of what the correct answer in this situation is no amount of attending will help. The fact that the feedback was so effective indicates that a longer warm up or one in which the symbols had a closer resemblance to the letters would have increased performance on the first task. It should be noted that warm up consisted only of performing on two very brief lines. In addition the warm up task which the Es defined as good definition of "same" only gave cues for right and left differences and not up and down on those symbols similar to the tall letters (see row 3 in figure 1).

An additional implication of this study is that it may serve to more clearly delineate the conditions under which readiness tests or normative studies should be run to acquire the results desired. It is the author's contention that we often make incorrect inferences from the results of such data when the tasks used tap skills other than those they were designed to measure. In the present case this would mean that studies like Davidson's which report norms for reversal discrimination are assuming that children know the Es definition of same and different. Thus, it would be well worth the time of any test constructor interested in validating criterion referenced tests to do some preliminary investigations into the proper conditions under which the test should be administered.

Warm up Symbols used in Conditions 1, 2, and 3.

Warm up Symbols used in Conditions 4 and 5.

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Table 1

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GROUP	% NO CONFUSIONS PRE-TEST				% NO CONFUSIONS POST-TEST				# CORRECT PRE	# CORRECT POST	INCORRECT OMISSIONS PRE	INCORRECT OMISSIONS POST	MEANS PRE	MEANS POST	ADJUSTED
Davidson's Study	d/10	n/53	g/10	b/13	d/-	n/-	g/-	b/-	—	—	—	—	—	—	
Present Study 1	13	50	13	6	13	50	19	19	246	265	224	183	74	55	58.26	64.95	69.09
2	25	50	19	25	25	63	19	31	280	293	202	196	40	27	66.10	67.94	68.16
3	13	75	13	13	50	88	25	38	256	241	219	99	64	79	61.96	74.71	77.00
4	19	69	13	38	44	75	44	44	261	258	171	126	59	62	71.29	76.97	74.59
5	50	86	38	44	75	94	69	69	246	254	129	67	74	64	75.07	85.57	81.30

Group 1 represents a replication of the Davidson Study done in 1934. Pre-training or warm-up consisted of circles and triangles.

Group 2 Warm-up with circles and triangles but with instructions urging subjects not to underline one that is different.

Group 3 As above with the addition of M & Ms for correct answer. Thus this group received feedback

Group 4 Warm-up was with symbols for which up-down, and left-right orientations are significant. Special instructions as in groups 2 & 3 were also given. No M & Ms were given to this group.

Group 5 As Group 4. M & Ms were given for this group's correct responses. Hence feedback was given.

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