LEFT-RIGHT CONCEPT ACQUISITION

by

HOWARD MARK SCHULMAN

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Howard Mark Schulman

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Chairman: Paul Satz
Major Department: Psychology

The present study attempted to develop a methodology for teaching children an accelerated concept of left-right discrimination (L-R) which shows transference to new stimulus situations. Five boys between ages 3-11 to 4-7 were pretested and found to be unable to differentiate their own lateralized body parts beyond a chance level. Each S was given five consecutive days of training on a L-R task. The task involved distinguishing the left and right panels of a test console. Multi-sensory prompts were gradually faded out as the child progressed in the training. Before and after each training session, three transference tasks were administered to the Ss. As a group, the five Ss showed no statistically significant learning of the training task nor any significant transference. Only two of the Ss appeared to have mastered the L-R training. One

of these two was able to further demonstrate conservation of the concept on the transference tasks. Among the shortcomings of the methodology was the inability to generate stimulus control in lateral cues. Several modifications and improvements were explored, which would foster both concept acquisition and conservation.

CHAPTER I
INTRODUCTION

The developmental psychology literature shows a long history of interest in the study of the development of concepts of right and left. Both clinicians and theoreticians have been interested in the formation and demonstration of this discriminative ability.

> Right-left discrimination . . . /was/ first observed in the form of acquired behavioral deficits in patients with cerebral disease. However, disturbances in right-left discrimination . . . can also occur as developmental deficits in mental defectives, in children with reading disability, and in brain damaged children as well as in adults. There can be little doubt that such developmental deficit has a far-reaching clinical and educational significance. (Benton, 1959, p. xiii)

Besides its usefulness in testing for various deficits and defects (Benton, 1968), left-right discrimination /L-R/ is a skill which all normal children acquire (to varying degrees) in the process of growing and developing. There are indications that the discrimination of L-R is one of several essential skills which form the basis for the acquisition of more complex sensorimotor, perceptual, and intellectual skills. As Boone (1965) observes: "Perhaps we need

to test routinely the left-right discrimination abilities of school children and teach those with left-right discrimination difficulties with a program of special instruction to distinguish 'left' from 'right'. The learning of reading, writing, arithmetic and music may be hampered for the youngster with left-right discrimination difficulties." (p. 133).

If L-R is as important to future learning as Benton and Boone imply, then the question of how the basic concept is acquired, increases in significance.

Bijou (1964) describes two alternative theories of concept attainment. These two theories might be called the "maturational" and the "learning theory" (or "behavioral") approach.

The maturational approach, best exemplified by Piaget and his followers, holds that concept learning follows invariant stage sequences (Wohlwill, 1963). Stages may be reached either via innate processes alone or, as many would stress, by a combination of the innate and the experiential (Sigel, 1964). The emphasis is on systematic development growing out of earlier foundations and developing in a fixed order tied to total maturation.

The behaviorists deny the necessity for invariant stage development. So long as the child is physically able to make the appropriate responses, it should be sufficient to arrange the environment to strengthen these responses (Bijou, 1964). The behaviorists imply that, while the apparent developmental "stages" may be a sufficient condition to attain certain concepts, the necessary minimum response repertoire may be available to the child much earlier, and thus concepts can be taught before they "develop."

The maturational versus learning controversy is an old one in psychology. The present study does not propose to resolve this controversy but to explore limited aspects of one developmental concept (L-R acquisition) which has generated much interest by clinicians, theoreticians and developmental psychologists in general. The following study has been designed to shed some light on the problem of left-right development by exploring two aspects of L-R concept training: (1) the applications of behavioral technology to the training of L-R to children who fall below the usual age for the attainment of this concept; (2) the transfer of this training to a different set of stimulus conditions. Before moving on to the immediate precedents for this study, one must understand something of the theory and history of the question of

L-R concept acquisition and its place in the area of child development.

Theories of the Development of L-R

Piaget (1928) describes three stages in the child's development of the L-R concept: (1) personal viewpoint, (2) viewpoint of others, (3) viewpoint of objects or of the relational judgement in general.

Most later theorists have accepted this three stage division despite minor differences over the nature of L-R development or the precise age at which each stage is attained (Elkind, 1961; Laurendeau & Pinard, 1970). Most test batteries reflect this three-part division (Piaget, 1924; Benton, 1959; Elkind, 1961; Laurendeau & Pinard, 1970). In more formal, structural terms, these stages have been described as: (1) pure egocentrism; (2) socialization or reciprocity of viewpoints; (3) complete objectification and reciprocity, (Laurendeau & Pinard, 1970).

Laurendeau and Pinard (1970) go into detailed descriptions of these stages. They begin with Stage 0 (Total Incomprehension) and break Stage 1 (egocentric) down into two substages (see "Development of the Problem" chapter) based on the degree of relativity and generalizability of the child's concept of L-R.

"Up" and "down"; "in front of " and "behind"; having fixed reference points (Boone & Prescott, 1968) are acquired at younger ages than the more abstract and relative distinction between left and right (Benton, 1959).

Benton (1968) approaches the concept of left and right somewhat differently than other theorists. He distinguishes two components to the complete concept of L-R: a somatosensory component (the L-R gradient of the 'body schema'), and a linguistic-symbolic component (successfully identifying and labeling the directions of right and left). The somatosensory component is best measured by testing a child's knowledge of the left and right sides of his own body (L-R SELF)--with consistent correct responses, or conversely, systematic reversal, indicating a basic differentiation of two spatial planes. The symbolic component at its simplest level, refers to consistently attaching the correct verbal label (left or right) to the already distinguished lateral body part. A complete symbolic grasp of L-R is demonstrated by a person's flexibility in applying L-R concepts (e.g. identifying L-R of another person, of objects, etc.). Benton hypothesized that the linguistic-symbolic component develops later than the somatosensory component.

Children and mental defectives who show systematic reversal in the identification of their lateral body

> parts and who fail to transpose their orientation in identifying the lateral body parts of the confronting examiner have not mastered the symbolic or conceptual component in right-left discrimination, despite a sufficiently differentiated right-left gradient. Conversely the normal adult who experiences difficulty in making the immediate discrimination and who relies on extraneous or stronger cues to accomplish it would seem to have an insufficiently differentiated right-left gradient, but at the same time complete appreciation of the conceptual aspect of the discrimination. (Benton, 1968,)

The conceptual approach of Laurendeau and Pinard (1970) takes into account systematic concept formation using a Piagetan model. The focus of this study will be on the first stage of L-R development, as described by Laurendeau and Pinard.

> The main characteristic of Stage 1 children is the understanding that the terms 'left' and 'right' are names or labels which do not relate to objects in a purely arbitrary and unstable fashion, but instead constitute spatial localization factors with a stable and regular reference. The child discovers, in effect, that these two terms refer to body parts which are placed on the same side, or to external objects which are considered as to the left or to the right depending on whether they are placed to the left or the right of the salient reference point which is the body itself. In his responses to the questions, then, he introduces a consistency which reflects this law of regularity, and the consistency of the responses often precedes even the knowledge of what left and right really are. It is clear that this principle of stability or regularity already reflects the child's grasp of a relationship of opposition between left and right . . . . Everything located on one side of him will be judged as to the left, for example, and everything on the other side will be considered to the right. Despite this understanding of the opposition relations

> expressed by these terms and also despite this constant coordination of objects with his own perspective, left and right remain essentially absolute terms that describe objects located in two contiguous and nonoverlapping spaces. Because the borders defining these spaces are determined with reference to a viewpoint which is unaware of itself, the child perceives neither their extreme mobility nor their continual fluctuation. (Laurendeau & Pinard, 1970,)

According to Laurendeau and Pinard's analysis, systematic reversals in young children show a higher level of concept formation than do mere random errors, in picking out body parts of a person standing opposite the subject (L-R OTHER). Such systematic reversal implies the child's systematic differentiation of left and right, and a projection of this spatial schema onto all objects in an egocentric manner (i.e. the child himself as the reference point). The later stages of L-R development recognize the dependence of the concepts of left and right on the person or object being referred to and not simply to the child's own orientation. The ability to correctly differentiate L-R OTHER does not generally develop until ages eight to 10 (Laurendeau & Pinard, 1970), while correct differentiation of L-R SELF can generally be seen at ages five to six (see following section). However, systematic reversals on a L-R OTHER task are often seen in children with fully developed Stage 1 L-R concepts--in fact such "errors" are to be expected among young children.

Normative Studies of L-R SELF

The various studies of L-R acquisition have been outlined in Table 1. The ages included identify the age of acquisition of a Stage 1 L-R SELF concept. The criteria for having mastered the concept varies somewhat, with most studies adopting the "75% Criterion"--that is, the age at which 75% of the Ss at that age level passed all of the items. This standard was first applied by Binet and Simon (1908, see Benton, 1959; Laurendeau & Pinard, 1970). They included a brief test of L-R in their first I.Q. scale.

Terman (1916, see Benton, 1959; Laurendeau & Pinard, 1970) included the three item L-R SELF test of Binet in his American adaptation of the Binet I.Q. scales, the Stanford-Binet. Terman however added three additional items to be administered should the child make an error on one of the first three (criterion was three of three, or five of six correct). This subtest was dropped from the 1937 revision of the Stanford-Binet for obscure reasons.

Piaget (1924--same as Piaget, 1928; also see Laurendeau and Pinard, 1970) introduced a 20 item test which measured all three stages of L-R development. Four of the 20 items measured L-R SELF.

Kladnitskaya (in Shemyakin, 1959) studied a group of seven year olds in a Russian physical culture class and found that when they were asked to raise their left or right hands, many of them made errors. About 30% turned the wrong way when asked to turn to the left or right.

Swanson & Benton (1955; also see Benton, 1959) used a 20 item test battery including: six L-R SELF items; four items with a crossed command (e.g. touch your right ear with your left hand); four items measuring L-R of another person; and six items performed with the S's eyes closed (both crossed and uncrossed commands). Crossed commands develop later (apparently between six and nine) than simple identification of single lateral body parts. (Benton, 1968) L-R skills begin to be manifested at about age five. No significant differences were found between items administered with the S's eyes closed or open (Most Ss followed this pattern. However, Benton [1968] found that some brain damaged patients and a few normal Ss showed patterns of differential responding on this variable.). Finally, the Benton studies looked at a sample of 12 children from an orphanage with I.Q. scores comparable to the larger sample and found that they did as well as other children their age.

In their 1963 study, Belmont and Birch concluded that L-R SELF is clearly stabilized at age seven. However by varying the number of test items, they found that they could "lower" the age of acquisition to five years. This issue of test reliability has all too often been overlooked in studies of L-R. A glance at Table 1 will quickly show that most studies used six or less L-R SELF items. The maximum number that Belmont and Birch used was seven items. The present study sought to increase the reliability of the criterion measure by increasing the number of test items.

Boone and Prescott (1968) introduced the Left-Right Discrimination Test (LRDT) which requires the child to identify left and right using large cards with colored circles printed on them (and incidently employing 17 L-R items as well as 23 control items). The test however was not a measure of "pure" L-R concepts, calling for identification of "higher left", "middle right", "lowest right", etc. Children below age five could not establish a basal score on this test. Performance on the LRDT improved linearly between ages five and ten.

Although Laurendeau and Pinard (1970) in their extensive study of 400 Montreal schoolchildren, placed the age of acquisition of L-R SELF at age seven (using the 75%

TABLE 1

Studies of L-R Discrimination

Study	Sample Population	# L-R Self Items	Age of L-R Discrimination
Binet & Simon (1908)[1]		2	6 years[(a)]
Binet & Simon (1911)[2]	Lower class French	2	7 years[(a)]
Bobertag (1911)[3]		2	7 years[(a)]
Terman (1916)[4]		3 or 6	6 years[(a)]
Piaget (1924)[5]	N=240; urban, middle-class ages 4-12	4	5 years[(a)]
Kolodnaya[6]	N=2		4 years
Kladnitskaya[7]	(30% of 7 year olds made errors)		
Benton (1955)	N=110; Mental defectives M.A. 6-9	10 (includes 4 crossed command items)	M.A. 6 years

Table 1 - continued.

Study	Sample Population	# L-R Self Items	Age of L-R Discrimination
Swanson & Benton (1955) Benton (1959)	N=158; middle-class; average I.Q.; ages 6-9	10 (includes 4 crossed command items)	5 years (estimated); 6 years (found chance)
Galifret-Granjon (1960)[8]	N=ca. 240; ages 6-14	4	6 years[(a)]
Elkind (1961)	N=210; ages 5-11	4	5 years[(a)]
Belmont & Birch (1963)	N=148; suburban; average I.Q. ages 5-3 to 12-5	7---------- 4----------	7 years[(a)] 5 years[(a)]
Boone & Prescott (1968)	N=600; ages 5-10	17 (LRDT)	5 & up
Laurendeau & Pinard (1970)	N=400; Montreal schoolchildren	6	7 years[(a)]

[(a)] uses "75% Criterion".

criterion), 24 of 50 Ss at age five got 100% of the L-R SELF items correct.

In general then, the normative studies indicate that the vast majority of children demonstrate complete mastery of Stage 1 L-R concepts (L-R SELF) between the ages of five and seven.

Correlates of L-R Conceptualization

Skills and concepts, of course, do not develop in a vacuum, but are tied to a variety of antecedent conditions and influence in turn a variety of consequent developments. Four major variables have been discussed in the literature as antecedents and/or correlates of L-R development: sex, I.Q., handedness, and reading skills.

Sex and L-R Discrimination

Since males and females show differential rates of development of various early milestones, the relationship of sex to the emergence of L-R conceptualization has aroused the interest of researchers.

Swanson and Benton (1959; Benton, 1959) reported no significant sex differences at any age level, nor did they find a consistent sex trend among the different age groups.

Galifret-Granjon (1960, see Laurendeau and Pinard, 1970), Belmont and Birch (1963), Boone and Prescott (1968),

and Laurendeau and Pinard (1970) all tested their data for differential performance trends by males versus females, and found no significant differences.

I.Q. and L-R Discrimination

Performance on L-R tasks has been associated with intellectual capacity ever since Binet and Simon compiled their original I.Q. battery in 1908 (Benton, 1959). L-R discrimination was included in the 1911 revision of the Binet-Simon scales and was also included in the German (Bobertag, 1911, see Benton, 1959) and American (Stanford-Binet--Terman, 1916, see Benton, 1959; Laurendeau & Pinard, 1970) adaptations. The L-R test discriminated between children at different levels of intellectual development.

Benton (1955, 1959) found that a mentally retarded group (C.A.--nine to 22) with M.A.'s of six, did not differ significantly from a comparison group of normal youngsters with similar M.A.'s, on a L-R task. Benton (1959) also compared normal children between six and nine years (C.A.) to a group of high I.Q. children (C.A.'s six to nine; I.Q.'s 116 to 138). The high I.Q. group demonstrated accelerated performances closely corresponding to their M.A.'s. "Indeed the close correlation between the two variables makes it possible to conceive of mental age alone as being an

adequate determinant of performance level." (Benton, 1959, p. 36)

Belmont and Birch (1963) studied a sample of above average I.Q. children. Although they did not find any reliable relationship between L-R scores and I.Q.s, they did note that there was a tendency for children of the same C.A. level who were in higher grades in school, to perform somewhat better than their less advanced peers.

In his 1968 review of the topic, Benton stressed the existence of an intellectual component in addition to the somatosensory aspects, especially, according to his theory, at higher levels of L-R conceptualization.

Laurendeau and Pinard (1970) concluded that the "mastery of concepts of left and right is rather directly related to differences in mental age and I.Q." (p. 259)

All of the above studies, it must be remembered, covered all aspects of L-R concept formation and not just stage 1 concepts.

Handedness and L-R Discrimination

> In considering right-left discrimination in children, the question arises as to whether there may be a relationship between this perceptual skill and the development of hand preference. Such a relationship might be postulated on the supposition that the perceptual skill actually develops out of, and is in part determined by, differential motor usage of the two hands. It would then be hypothesized that a child who

> shows a decided preference for the use of either hand (i.e., is strongly right-handed or left-handed) will show a higher degree of efficiency in right-left discrimination than the one who does not show such a preference (i.e., is confused or ambidextrous with respect to handedness). (Benton, 1959,

This statement expresses the basis for Benton's theory of L-R development--linguistic-symbolic conceptualization developing from an earlier proprioceptive distinction between left and right body gradients.

Benton and Menefee (1957) offer weak empirical evidence supporting a relationship between L-R and handedness. Benton (1968) cites diverse evidence in support of this hypothesis. However, Belmont and Birch (1963, 1965), Coleman and Deutsch (1964), and Laurendeau and Pinard (1970) minimize or discount the contribution of hand preference to L-R development. The research in this area thus appears to be far from conclusive.

Reading Problems and L-R Discrimination

One of the most important (in terms of future development) proposed correlates of slower than usual L-R development is the emergence of later reading problems.

L-R discrimination abilities it is hypothesized, may be a precursor to reading skills (e.g. the only difference between "b" and "d" is the direction of the lower part of the letter [Hermann, 1959 in Benton, 1962]). If this is the

case (Satz & Sparrow, 1970; Satz & Friel, 1972b), then a test of L-R has potential use as an early predictor of potential reading problems.

Harris (1957) compared 316 cases of children with marked reading disabilities, with an unselected sample of school children of the same age. "At age seven, the most striking difference between . . . groups are the higher proportions of the reading cases who show confusion in identifying left and right and mixed hand dominance." (p. 293) Additionally, "ability to distinguish between left and right and a clear preference for one hand develop slowly in a significantly larger percentage of reading disability cases than in unselected children. This suggests the presence of a special kind of slowness in maturation, possibly neurological in nature." (p. 293)

Balow (1963) in a study of first graders, did not find knowledge of left and right to be a significant factor in reading achievement.

Coleman and Deutsch (1964) evaluated many studies in the area of L-R and reading problems. They looked at a sample of lower S.E.S. children (ages nine years five months to 12-5) and found some evidence of a correlation between L-R confusion and reading difficulties in younger children,

but no clear evidence of a causal relationship. While there are probably some retarded readers who show L-R disorientation (as well as mixed handedness), they concluded that this group makes up only a very small portion of problem readers. However, according to Satz and Van Nostrand (1972) children who develop reading problems would be expected to have L-R discrimination problems at a much younger age than in the Coleman and Deutsch sample.

Comparing a group of students (mean age = 9.8 years with reading problems to matched controls who were average to good readers, Lovell, Shapton, and Warren (1964) reported that a number of the poor readers did poorly on a test of L-R SELF.

In a comparison of children who systematically reversed right and left with a control group, Benton (1959) found that the systematic reversers were deficient in the development of language skills (particularly the older children, i.e. eight and up). Their mean reading scores were more than one year lower than those of the controls. In his 1968 paper however, Benton questions whether a clearly developed L-R gradient is a necessary prerequisite for the spatial and directional habits necessary for reading. He concludes that: "when the crucial variable of intelligence level is

controlled in comparison of normal and dyslexic children. . . differences in respect to right-left orientation are found to be minimal and, from a statistical standpoint, nonsignificant." (p. 756) Benton (1968) attributes the trend toward more systematic reversals by dyslexics, to the underlying linguistic-conceptual impairment of dyslexia itself.

Belmont and Birch (1963) appear to discount the causal relationship between L-R confusion and reading problems, suggesting that there may be more general neurological factors underlying both. However in their 1965 paper, the same authors found that L-R SELF items can be used to discriminate between normal and retarded readers (age nine-four to 10-4). Despite these statistically reliable results, it should be noted that 131 of the 150 retarded readers in the sample achieved perfect scores on the L-R SELF items.

Satz and Sparrow (1970) in reviewing this area concluded that there was significant evidence of a relationship between L-R confusion and dyslexic problems. Satz and Friel (1972b) reported that children who were found to be high risks for developing reading problems show difficulties in L-R when tested in both kindergarten and grade one. However, L-R discrimination difficulties did not significantly discriminate high and low risk subjects when a kindergarten

sample alone was used (Satz & Friel, 1972a)--perhaps because L-R abilities are just developing in all children at this age and are not yet discriminative.

In many cases, early L-R difficulties are correlated with later reading difficulties. Precisely what the underlying mechanism is, is subject to some speculation (Satz & Sparrow, 1970; Satz & Van Nostrand, 1972). Further research into this proposed relationship may help to clarify these neuropsychological factors and perhaps assist in the early identification of potential problem readers. Should L-R development be shown to have more than a mere correlational relationship to later reading problems, the methodologies tested in the present study may be shown to have remedial or even preventive value.

CHAPTER II
DEVELOPMENT OF THE PROBLEM

Having reviewed the theoretical and normative studies of L-R development, one is left with the question of whether a concept of L-R can be taught to children who fall below the usual age for the mastery of this concept.

Jeffrey (1958) was able to train a group of four year olds on a task approximating the L-R SELF discrimination. The children were presented with two stick figures with either the left or right arm raised. Using a simple programming paradigm, the children were reinforced (listening to music) for labeling the arms correctly (one arm was to be called "Jack," and the other "Jill"). The experimental group was given 20 trials on this task before being given an intermediate task which called for them to make a motor response to the same stimuli (pushing one of two buttons corresponding to "Jack" and "Jill"). After mastering that, they returned to the original task. The controls, who did not have training on the motor response task, did not learn the criterion task (verbal response) despite reinforced training. The experimental group had no difficulty with the task.

While it is clear from Jeffrey's study that four year olds can be taught to discriminate between left and right, it is not clear whether or not the children have learned to generalize this concept to new stimulus situations. To demonstrate the latter, a test of transference of training is necessary. Specifically, one wonders if Jeffrey's Ss could, following his training, identify which of their own arms was "Jack" and which was "Jill." It was this question which prompted the present study.

While Piaget himself described only gross stages of L-R concept acquisition and development, Laurendeau and Pinard (1970) studied these stages in more detail, and were able to make finer distinctions. They were able to break Stage 1 of L-R development into two substages--1A and 1B. The failure to show transference of L-R concepts from one situation to another is characteristic of children at substage 1A. This "is explained by the very unstable and still undeveloped character of the coordinations intervening in the concepts of left and right: the child is unable to transpose into a second situation, or simply to conserve, the strategy which produced success with the first problem." When children reach substage 1B "the definition of the terms "left" and "right," as incomplete and limited as it

still is, is structured strongly enough to be generalized (even too much) to various situations requiring the use of these concepts." (Laurendeau & Pinard, 1970, p. 288). It is apparent that L-R concept acquisition as it normally emerges, is not a single step process. Sigel (1964) feels that concept acquisition in general is not unidimensional. He identifies four processes contributing to concept learning: discrimination learning ("a primary step"--p. 210), perception, transposition, and generalization.

Taking into account both Laurendeau and Pinard and Sigel, it appears that Jeffrey's Ss learned a 1A concept involving perception and discrimination. Substage 1B apparently involves the processes of transposition and generalization. Jeffrey's study did not measure the transference of training from the original training situation to a new one.

The word "conservation" was used by Laurendeau and Pinard in the above quotation. "Piaget refers to 'conservation' as the ability to hold a property invariant in the face of transformations." (Sigel, Saltz & Roskind, 1967, p. 471) This subsumes the processes of generalization and transposition.

Given a concept, Piaget is interested in whether the child can conserve the essentials despite differences in the stimuli. Substage 1A children do not, by definition, show conservation of L-R in the face of new stimuli. Laurendeau and Pinard (1970) place substage 1A acquisition sometime before age five (they did not adequately sample this age group and so cannot more precisely specify the age range). Substage 1B acquisition was placed at about five years-eight months. It would therefore be expected that four year olds could learn a substage 1A L-R concept while failing at a conservation measure. This raises the question of whether four year olds can be taught a sufficiently complete concept of L-R so as to be able to generalize (conserve) the concept beyond the immediate stimulus situation.

As stated in the introduction, the present study is not designed as a test of the long-running, complex controversy over learning versus maturation. Rather the objectives are more modest ones--namely to teach a simple L-R concept to four year olds using an operant methodology, and to explore the conservation of the concept following this training. Using a small N (as is proposed in this study) one cannot hope to examine conclusively the many correlates

of L-R development reviewed earlier, nor indeed to serve as a critical test of L-R concept acquisition. A more basic preliminary study seems called for to develop a simple technique for training Stage 1 L-R concepts and to explore the parameters of the conservation of this concept in a new stimulus situation.

In order to develop a methodology for training children in L-R concept acquisition, pilot research (Schulman, 1972) was undertaken. Based on this research and the training paradigm it produced, Allen (1972) designed a similar study, modifying some of the problems identified in the pilot study.

Despite Allen's overall conclusions in support of the training paradigm, only one of her three Ss learned the L-R transfer tasks. The conclusions to be drawn from this study remain ambiguous. The one S who showed the best performance on the measures of conservation, did poorest overall on the training task--never totally mastering it. A second S showed at best a tenuous grasp of L-R concepts; while the third did not attain a demonstrable understanding of L-R despite the training. Allen's explanation for her findings suggest that perhaps the Ss' contact with the training apparatus was spread over too long a period of

time, with too little total training. The viability of the technique of training the L-R concept remains to be clearly demonstrated.

One major factor in the failure of two of Allen's three Ss on the transference tasks appeared to be the limited experience they had with the training task, as well as the fact that training sessions (three) were each a week apart, allowing for possible extinction effects. The present study seeks to expand upon both the earlier pilot data, and Allen (1972) and more fully examine L-R concept acquisition and its subsequent transference to a new stimulus situation.

It is proposed that by establishing lateral placement as the controlling stimulus in the concept acquisition training, the concept will show transference to the new stimulus situation. This is intended as an exploratory study of conservation of L-R conceptualization given systematic concept training aimed at fostering stimulus control in the lateral placement of the stimuli. Failure to demonstrate the proposed transference will not necessarily support an alternative maturational hypothesis. However positive results on this small group of children would have interesting implications for the early training of concepts in general and for L-R conceptualization in particular.

CHAPTER III
METHOD

Subjects

The Subjects consisted of five males--age range 3-11 to 4-7. Each child was initially prescreened approximately one week before the initial training session with a Peabody Picture Vocabulary Test (Form B) to eliminate potential Ss with I.Q.'s below the normal range. The five Ss chosen had I.Q. scores ranging from 102 to 120. The prescreening also included the three tests making up the Criterion Battery (see Procedure) to eliminate those children who already could discriminate right and left. To be chosen as a S the child had to attain scores between three and seven (out of a possible 10) on each of the tests ($p \geq 8 = .05$, $p \leq 2 = .05$).

The parents of the children were paid only if the child attended all five training sessions. Much time was spent emphasizing the importance of not practicing L-R concepts with the children while the experiment was still in progress.

Procedure

Tests Administered

A complete Criterion Test Battery (CB) consisted of: (1) a test of L-R SELF, (2) a test of L-R OTHER, and (3) a test of L-R discrimination of non-body stimuli--Arrows Test.

In the test for L-R SELF, the child was asked to point to various parts of his own body (e.g. left hand, right foot, etc.). Five general (non-lateralized) body parts (e.g. head, stomach, etc.) were also included to prevent perseverative responses and to control for attentional errors (see Appendix A for L-R SELF Test). The test for L-R OTHER used the same items as L-R SELF but the child had to point to the appropriate body parts of the examiner who sat facing him (see Appendix B). Both L-R SELF and L-R OTHER were scored on a zero to 10 scale (0 = no items correct, 10 = perfect score).

The Arrows Test consisted of 10 four inch by six inch index cards, with a three inch arrow drawn on each of them. The arrows were drawn at 45°, 90°, 135° (pointing right), 225°, 270°, and 315° (pointing left), angles. The child was asked to tell if the arrow pointed to the right or to the left. The test was scored on a zero to 10 basis (0 = no items correct, 10 = a perfect score).

All three tests contained an equal number of left and right items, all in random order. The order of the tests in the CB was Arrows, L-R SELF, and L-R OTHER.

A complete testing session (SES) consisted of an initial CB (CB_{pre}), L-R training, and a second administration of the test battery (CB_{post}). Each child had five such sessions, one each day for five consecutive days.

Following SES 1 and SES 5, the children were asked to describe to the E's assistant what they had done and what they thought the whole procedure was about (phenomenological examination). If the children could not respond to this, they were asked to pretend that they were describing what they had done, to their best friend--how would they describe what they had done? Neutral prompting questions were used to elicit as complete a description as possible.

Training--Instrumentation

The L-R training employed a BRS-LVE Human Test Console (HTC-603). The following accessories were arranged on the panel (see Figure 1): two Stimulus Tapping Keys (STK-603) lit with three bulbs each, and an M & M Dispenser (MMD-601) modified so that it could be centered on the console. The M & M Dispenser also contained a warning light above it. The Human Test Console was controlled by a BRS-LVE solid

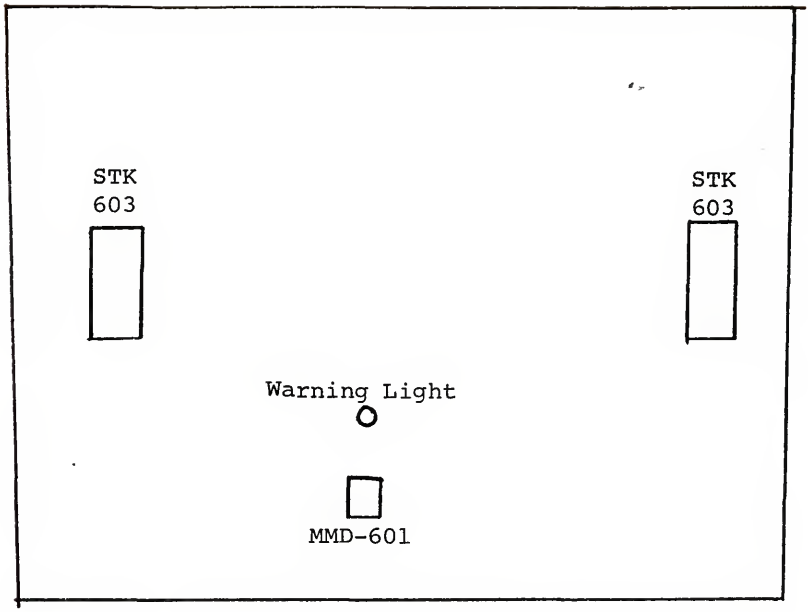

Figure 1. BRS-Foringer Human Test Console (HTC-603) with Accessories.

state logic system. This in turn was triggered by a Sony Stereo Center (TC-630) tape player-recorder which delivered the auditory stimulus. The Stimulus Tapping Keys were wired to allow any or all of the three bulbs to be shut off permitting a range of intensity for the visual stimuli.

A set of 8 ohm RMS Stereo Headphones (HP-8X) were worn by the S. Potter Brumfield Type 37 Bu, 6V AC Buzzers ("vibrator cuffs") set in velcro strips were placed on each of the Ss' forearms. The buzzers were powered by a Stancor P6465 transformer (6.3V @ 0.6 Amp.) and were set at a vibrating frequency of 60 cycles.

Training--Procedures and Instructions

The child was seated in front of the Human Test Console (see Fig. 2). The headphones and vibrator cuffs were placed on the S while the following instructions were read to him:

> We're going to play a game now (SHOW CHILD HEADPHONES). Do you know what these are? Well, you're going to hear someone say the word 'left' or 'right' when I put these on you. You're also going to see one of these windows light up and you're going to feel something on your arm--kind of like a tickle (SHOW ARM CUFFS TO CHILD AND GIVE A SAMPLE). I want you to do two things: first I want you to say the word that you hear, then I want you to push the window that lights up (DEMONSTRATE THIS). The tickle will be on the same side as the lighted window, so if you hear the word 'right' and feel the tickle on this (R ARM), and see this window (POINT) light up, I want you to say 'right', and push this window with this (R) hand. If you do it correctly you'll get an M & M from here (POINT). If you don't do it correctly, nothing will come out. You can save

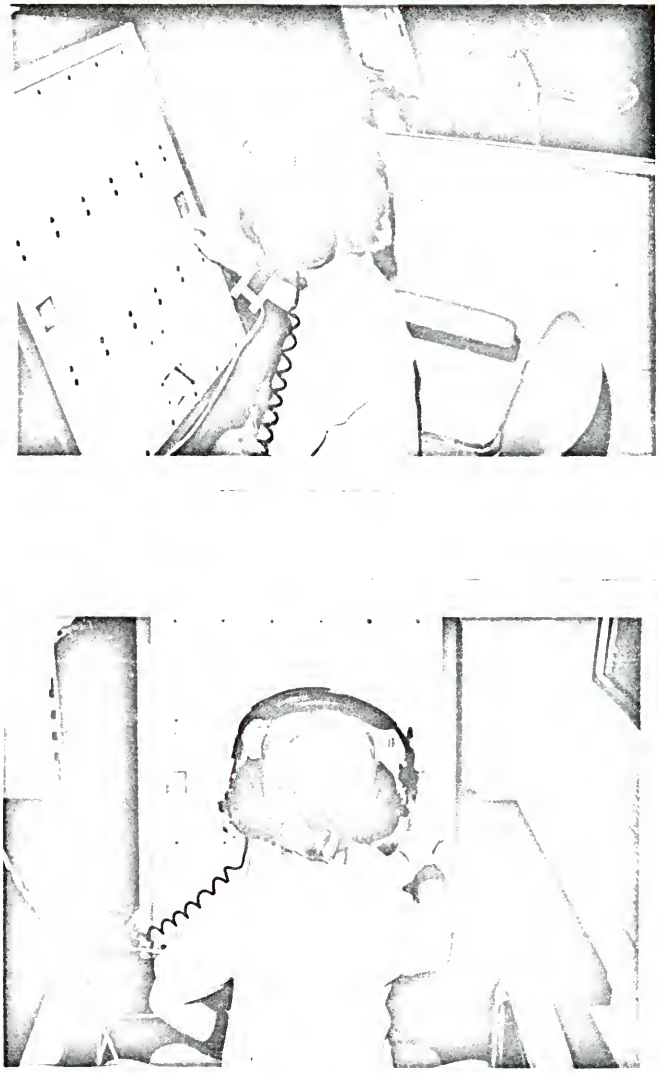

Figure 2. The S Seated in Front of the Human Test Console.

> up your M & M's in this dish here if you want to. OK? When you are all finished, you can use your M & M's to buy something from the 'store'. You can trade your M & M's for something from our prize store. (CHECK TO MAKE SURE CHILD UNDERSTANDS)
>
> Now one other thing. Just before you feel the tickle and see the lighted window and hear the word 'left' or 'right', this (POINT) will light up to tell you to get ready.
>
> Remember, when the window lights up and you feel the tickle, and you hear the word 'right' or 'left', you say the word you heard and push the lighted window with the arm that you feel the tickle on. If you do it correctly you get an M & M. When you have a whole bunch of M & M's you can trade them in for a prize.

The child was then given several practice trials.

The six phases in the L-R training are outlined in Table 2. Each phase change consisted of a fading of one or more of the stimulus dimensions (auditory, lateralization, tactile, or visual). During Phase 1 (P1) all of the stimuli were at maximal intensity with the auditory stimulus almost totally lateralized in one or the other headphone channels (corresponding to the laterality of the other stimuli). The total trial interval was 10 seconds (including the warning light). The timing of the various stimuli for P1 are illustrated in Fig. 3. The timing remained constant across phase changes.

P1 continued until the child reached the criterion of seven consecutive correct trials at which time he moved to

TABLE 2

Phases of the L-R Training Task

P_1	P_2	P_3	P_4	P_5	P_6
A = 5	A = 4	A = 3	A = 2	A = 2	A = 1
V = ***	V = ***	V = **	V = *	V = OFF	V = OFF
Vibrator----------			Vibrator Off----------		

A = Auditory stimuli

5 = monaural
4 = largely monaural
3 = intermediate
2 = largely binaural
1 = binaural

V = Visual stimuli

*** = panels are bright (lit by 3 bulbs each)
** = panels are dimmer (lit by 2 bulbs each)
* = panels are very dim (lit by 1 bulb each)
OFF = panels do not light up

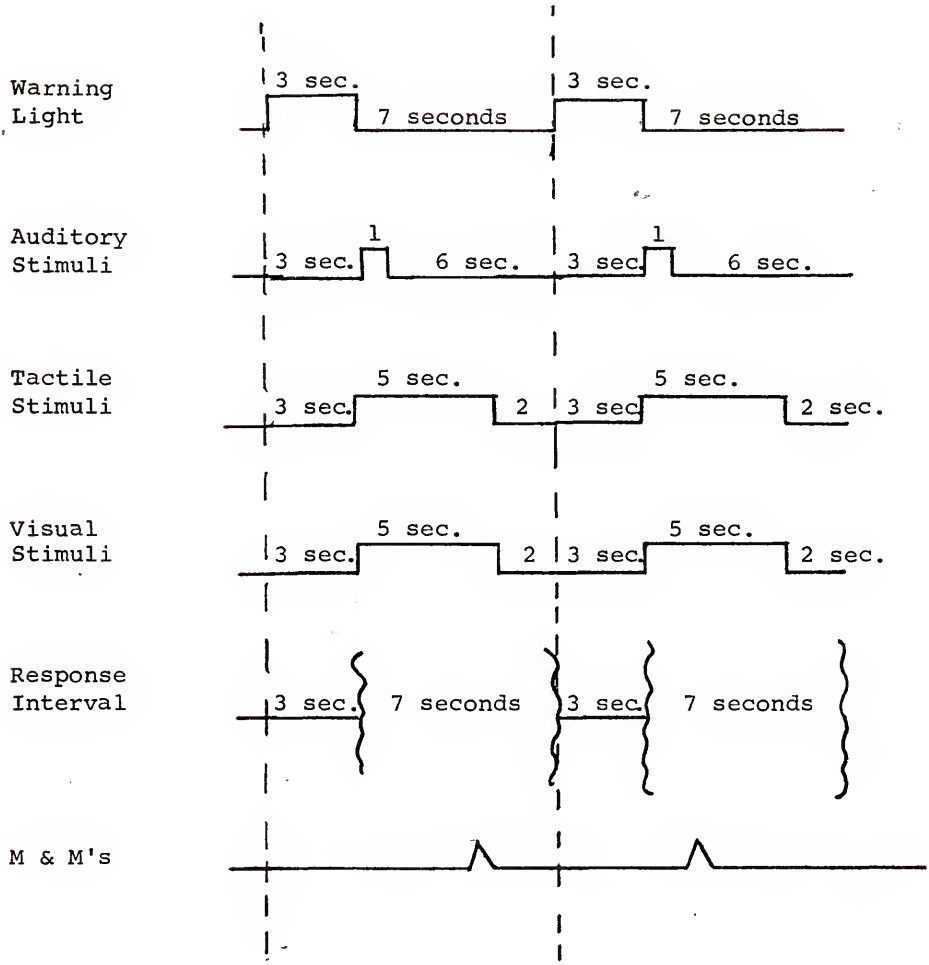

Figure 3. Timing Diagram for Training Trials During Phase 1.

<u>Note</u>: Stimuli terminated by a response.

the next P level (the criterion for movement to succeeding P levels remained at seven throughout).

After completing P1, the arm cuffs were removed and the child was told:

> You're doing very well. Now we're going to do the same thing only now you won't feel the tickle. You'll only see the lighted window and hear the word "right" or "left". I want you to repeat the word and push the lighted window the same as before. OK?

The child continued to work in P2 until the requisite seven correct consecutive responses were made.

P3 and P4 were not preceded by any new instructions. Before P5 however the S was told: "This time I'm going to turn off the lights in the windows and I want you to repeat the word 'right' or 'left', and push the correct window even though they don't light up. You will still get M & M's when you say the correct word and push the correct window. Any questions?"

P6 was not preceded by further instructions. Following P6 the CB was readministered (CB_{post}). The child was then permitted to trade in his M & M's for a toy or other candy.

Left and right trials were randomized. The child continued to work on the training apparatus until he had attained criterion at all six phases. If he failed to reach criterion, he continued at the same phase until he

completed the maximum of 125 trials for the session. The maximum length of a training session was between 15 and 20 minutes.

Methodological Issues

Subjects

As reviewed in earlier sections, there are numerous parameters of L-R concept formation which are of interest and importance. Since the present study was designed to concentrate on training and conceptual factors, between subject differences (sex, I.Q. range) were held constant, and a small sample design concentrating on within subject differences, was chosen. The contribution of handedness to L-R development is open to question and was not tested in the present investigation.

Tests Administered

In response to Belmont and Birch's (1963) criticism of studies which used too few criterion items in their L-R testing, 10 lateralized items were included in this study.

The children in this investigation were not directly trained in responding to L-R OTHER, and one would hardly expect four year olds to demonstrate proficiency on this difficult task. However, Laurendeau and Pinard (1970) distinguished two levels of Stage 1 concepts. At Stage 1B,

the concept of an egocentric left and right is so strong that the child is consistently correct when tested on L-R SELF, and consistently in error (systematic reversal--using his own body as a reference point) on L-R OTHER. At Stage 1A (a somewhat earlier substage) the child is inconsistent in his responses to L-R OTHER, while showing consistent correct performance on L-R SELF. It was therefore to measure the level and strength of L-R acquisition, that L-R OTHER was included in the present research.

The Arrows Test was designed as an extrapersonal measure of L-R which, unlike Piaget's tests for extrapersonal L-R (Piaget, 1928; Laurendeau & Pinard, 1970), does not require higher level L-R concepts. It is based essentially at an egocentric, Stage 1, level. Allen's (1973) L-R Card's Test seems to call for Stage 3 judgements while ostensibly measuring Stage 1 concepts. The Arrows Test is closer in both stimulus and response characteristics to the training task than either L-R SELF or L-R OTHER. It was hypothesized that it would prove easier for the subjects and serve as an intermediate measure of transfer of training.

Training Task

Laurendeau and Pinard (1970) emphasize that the usual sequence in L-R development is that the child uses his body as a reference point to distinguish laterality (egocentric L-R). Jeffrey's (1958) design (using an external L-R referrent) goes counter to this model of normal development and was therefore rejected in favor of keeping the child's own body as the point of reference.

Jeffrey (1958) suggests that the manipulation of the stimulus dimension might facilitate learning of the L-R task. Terrace's (1963 a & b) technique of errorless discrimination (fading) seemed to offer a precise means of manipulating this dimension. Sensory prompts were therefore included, using a fading training design. Benton (1968), in distinguishing between the somatosensory and linguistic-symbolic components of L-R, points out the multiple factors involved in the concept. Therefore both somatosensory (tactile) and linguistic prompts were included, as well as sound lateralization and visual cues. The ultimate aim of the L-R training was to establish laterality as the controlling stimulus.

On the response side, Jeffrey (1958) demonstrated that a tactile response facilitated the acquisition of the verbal

L-R discrimination. Therefore a tactile response (as well as a verbal response) was employed in the training design.

Statistical Treatment

Since this study was designed to use an extremely small N, statistical analyses were necessarily kept to a minimum. The Friedman Two-Way Analysis of Variance by Ranks (Siegel, 1956) was applied to test for the effects of the training sessions on the S's performance on the criterion measures. A stepwise regression (BMD-02R program) was applied to the data for L-R SELF and L-R OTHER to test for linear trends in CB performance across training sessions.

Data from a pilot group of four Ss (Schulman, 1972) was combined with the present data for several supplementary statistical analyses. Since the data thus pooled is not quite comparable, it was used only to look for trends not otherwise easily ascertained with the smaller N. These pilot Ss were given an earlier version of the training paradigm (somewhat longer--criterion was 10 correct responses; auditory cues were always lateralized; four training sessions were held, each one week or more apart). Since an earlier version of the Arrows Test was used, those scores were not used in the supplementary analyses. The scores on L-R SELF and L-R OTHER in these analyses, represent

performance over the course of four training sessions without regard for the timing of these sessions. The following statistical treatments were applied: (a) Wilcoxon Matched-Pairs Signed-Ranks Test (Siegel, 1956) to test for differences between criterion scores on the first pre-training CB and the CB following SES 4; (b) Spearman Rank Correlation Coefficient tests were performed on the I.Q., age, and L-R data to measure any performance-intelligence, or performance-age relationships.

CHAPTER IV
RESULTS

The performance of the five Ss on the L-R SELF test is illustrated in Figure 4. None of the Ss made any errors on the non-lateralized control items in the CB. It is apparent that none of the Ss except for J.R. showed appreciable transference of learning from the training sessions to L-R SELF. A Friedman Two Way ANOVA did not produce any statistically significant differences between sessions across subjects.

The Arrows test was also subject to the Friedman Two Way ANOVA. Despite the greater similarity of this test to the training task, this statistical analysis was again non-significant. The performance of the Ss on the Arrows test is plotted in Figure 5. J.R. began with a perfect score of 10 correct responses (on the pre-screening administration of this test over a week earlier, he scored seven out of 10 correct). He maintained this superior level of performance across the training sessions. J.S. showed some improvement following the last training session. However this was not paralleled in his performance on L-R SELF or L-R OTHER, nor

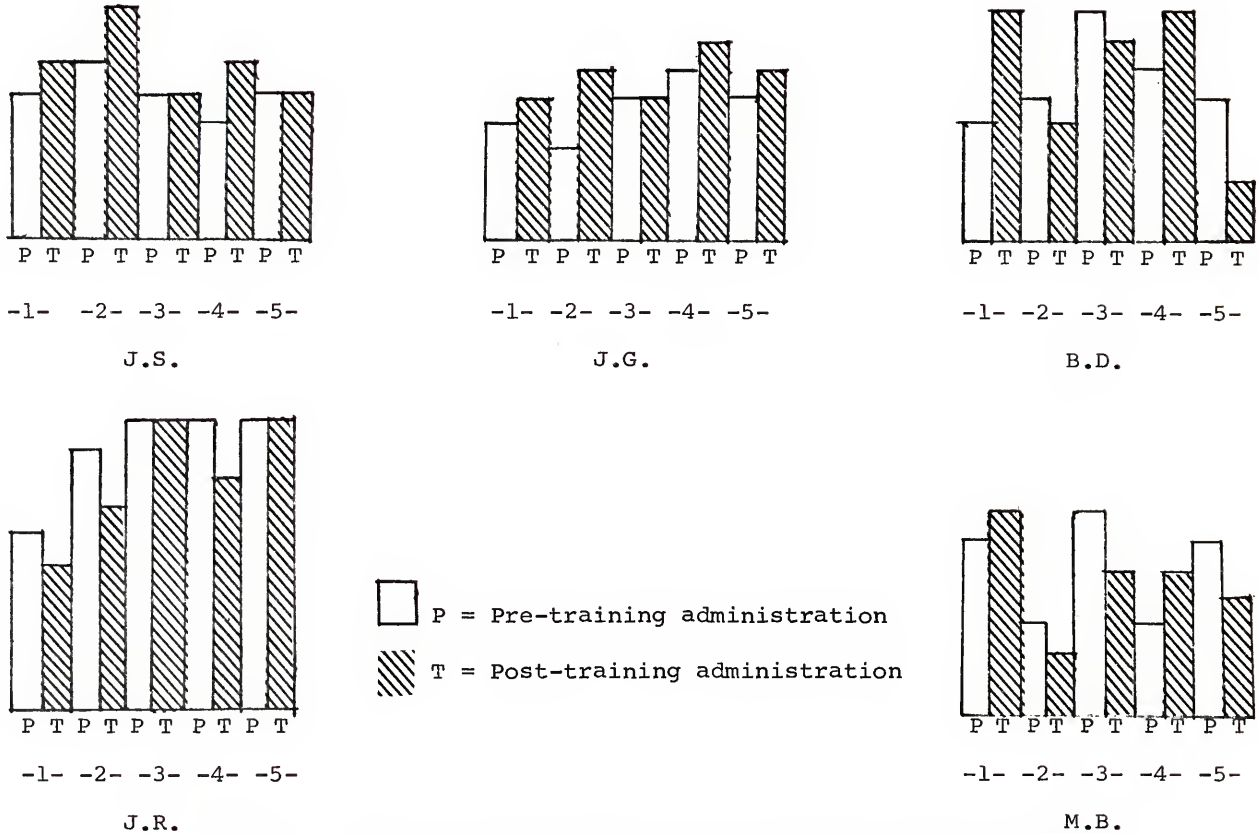

Figure 4. Subjects' Performance on L-R SELF--Correct Responses.

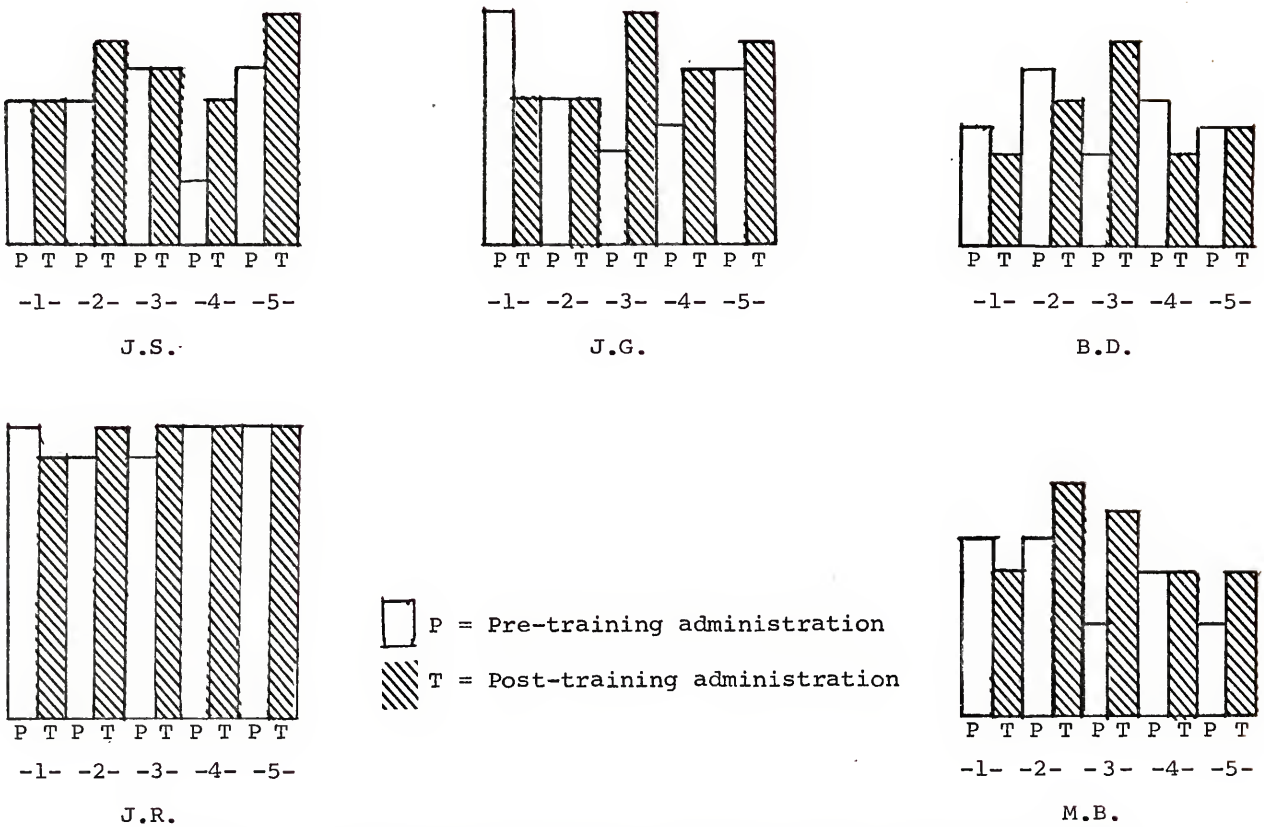

Figure 5. Subjects' Performance on Arrow's Test--Correct Responses.

is this improvement sufficiently great nor part of a pattern of improvement, to imply acquisition of a L-R concept.

The data for the L-R OTHER test is presented in Figure 6. Improvement on this test, for this age group, would be indicated by a decrease in correct responses (consistent reversal). Again J.R. is the only subject to perform in the predicted direction. As with the other tests in the CB, the Friedman Two Way ANOVA performed on the Arrows scores, was not significant.

When stepwise regressions were applied to the CB data, no significant linear trends were found.

The error trends for each of the participants on the training task are presented, according to training session, in Table 3. There are no clear cut patterns appearing across the sessions. J.S. and J.R. made somewhat fewer errors at the last two sessions than at the first two. However J.G., B.D., and M.B. show an increase in errors for sessions 4 and 5. The subject with the fewest total errors on the training task, J.S., did not show a comparable performance on any of the tests in the criterion battery. J.G. made many more errors (in fact more errors than the total of the other four Ss) on the training task than the others,

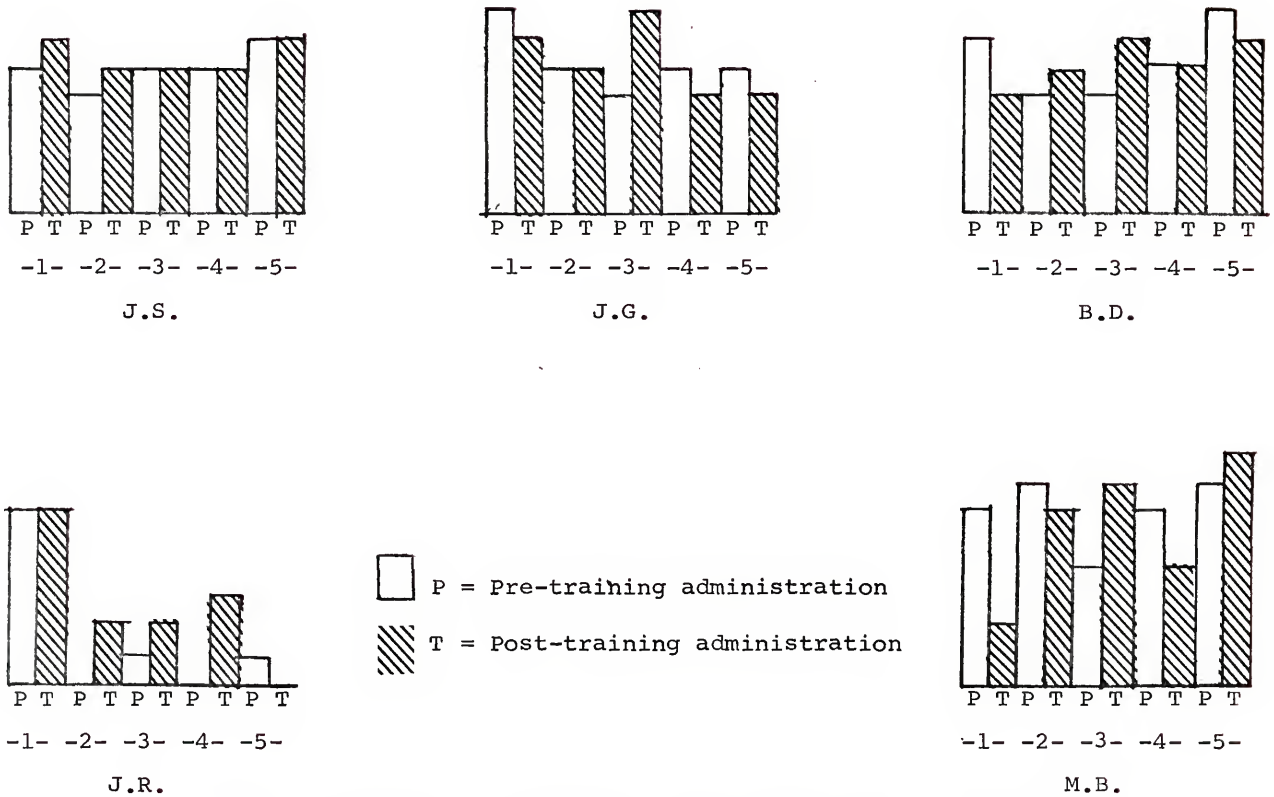

Figure 6. Subjects' Performance on L-R OTHER--Correct Responses.

TABLE 3

Subject Errors on Training Task by Session

Session	J.S.	J.G.[a]	B.D.	J.R.	M.B.
1	5	37+	17	14	11
2	3	39+	1	3	8
3	4	44+	3	4	0
4	0	53+	11	0	8
5	1	54+	10	1	34
Totals	13	226+	42	22	61

[a] + indicates that criterion of seven consecutive correct trials were not met at the end of 125 trials for either P_5 or P_6.

not reaching criterion for P_6 at sessions 1, 2, 3, and 5, and not reaching criterion for P_5 at session 4. Nevertheless he did not perform the poorest on the CB. In fact, he showed a slight improvement on L-R SELF and L-R OTHER over the course of the five sessions.

Table 4 illustrates subjects' errors on the training task broken down by phase of training. It appears as though P_5 and P_6 were the most difficult parts of the training for all the Ss. P_1 thru P_4 were rather quickly mastered by all the Ss. J.G. never mastered P_6 and performed very poorly at P_5. Table 5 shows the S's errors at P_5 and P_6 of the training for the last two training sessions. J.R., who performed best on the CB, went through these phases of training without error. J.S. too seems to have mastered P_5 and P_6 (only one error). All the other Ss still had difficulty with the last two phases right through the fourth and fifth training sessions.

Phenomenological Inquiry

Following SES 1 and SES 5, the Ss were interviewed to elicit their perceptions of the testing and training procedures. The following comments were made following SES 1:

J.S. "I don't know. Q I went to bed. Q I don't know. I got some M & M's, then I pushed the button, then I was done."

TABLE 4

Subject Errors on Training Task by Phase

Phase	J.S.	J.G.[a]	B.D.	J.R.	M.B.
P_1	3	4	0	4	0
P_2	2	0	1	1	0
P_3	1	0	0	1	0
P_4	0	1	1	3	7
P_5	4	99+	24	10	15
P_6	3	123+	16	3	39

[a] + indicate that criterion of seven consecutive correct trials were not met at the end of 125 trials for one or more sessions.

TABLE 5

Subject Errors at SES 4 and 5 on Phase 5 and 6

Phase	J.S.	J.G.[a]	B.D.	J.R.	M.B.
P_5	0	89+	7	0	12
P_6	1	18+[b]	5	0	30

[a] + indicates that criterion of seven consecutive correct trials was not met at the end of 125 trials.

[b] SES 5 only. At SES 4 J.G. never reached criterion on P_5 and therefore never got to P_6.

J.G. "I don't know. M & M's came out. Q I don't know. I went in here the other day."

B.D. "We winned these M & M's. I picked everytime that lady say something. I knew what the right word was."

J.R. "I can't remember. Q Got M & M's. Q Push the buttons."

M.B. "I don't know. Q (What would you tell your friends you did today?) Um, I would tell them nothing. Q I played with friends. Q I worked the M & M machine and I got a lot. Q Press those buttons."

Following the final session, the children made the following comments:

J.S. "Put the ear muffs on, then the tickle touch is on, then look at the arrows. Q (How do you get M & M's?) From the machine. Q (Why don't you get M & M's all the time?) They get stuck. Q I don't know."

J.G. "I did that (pointed). Q M & M machine. Q I got some M & M's. Q I pressed the window. Q Then I got some M & M's. I had to put them in a dish. Q I had to press the button. Q (Say anything?) A word. Q (How come you don't get M & M's all the time?) Cause. Q When I press the wrong buttons. Q The light was on. Q (How about when the light was not on?) I don't know."

B.D. "You got to push the buttons to get M & M's. Q You got to think. Q The sound says right or left (He identified the buttons on the machine as the right one and the left one--incorrectly.)."

J.R. "Nothing. Q Nothing. M & M's. Q (From where?) Out of the machine. Q Push the button. Q I hear something out of those. Q Right or left. Q Push the button when I hear 'right' (he pushed the left button but immediately corrected himself).

When I hear 'left' I push this button. An M & M comes out if you do it right."

M.B. "You press the buttons. Q Do the arrows and point to yourself. Q (What do you hear?) Left and Right. Q M & M's. Q Say a word. Q Right and left. Press the button."

It was observed that when given the Arrows Test, J.R. used his hands and his body to orient himself to left and right.

Supplementary Analyses

Combining the data for the five Ss (except for SES 5) with the data gathered from the four pilot Ss (Schulman, 1972), Wilcoxon Matched-Pairs Signed-Ranks Test were used to test for differences between Pre-SES 1 scores and Post-SES 4 scores on L-R SELF and L-R OTHER. Neither of the two analyses proved statistically significant.

With so small a sample, the effects of I.Q. differences are difficult to accurately assess. A Spearman Rank Order Correlation of Peabody I.Q. scores and L-R SELF scores did not demonstrate any significant relationships. A similar test to assess age--performance relationships was similarly non-significant. Correlations of I.Q. scores and age with L-R OTHER scores were also performed, and proved non-significant.

Of the four pilot Ss, one performed much like J.R. After one training session, he attained a perfect score on all three criterion measures, and maintained this level. The other three Ss did not master the tasks. No data on the performance of these Ss during the training sessions is available.

CHAPTER V
DISCUSSION

This study examined two aspects of L-R concept formation--the training of the basic concept (substage 1A) and the conservation of the concept in different stimulus situations (substage 1B).

Despite exposure to what was designed to be an intensive period of training in the basic concept of L-R, only two of the five Ss appear to have mastered the L-R training task. Only one of these two Ss (J.R.) showed appreciable transference of learning to the Criterion Battery. These results raise serious questions about the viability of the design and methodology of the basic L-R training task.

Looking at Allen's (1972) three Ss and Schulman's (1972) four pilot Ss, one subject in each study seemed to have shown transference to the criterion tests following training. This makes a total of three out of 12 Ss, when the present study is included, who were able to demonstrate conservation of L-R conceptualization following somewhat similar training paradigms. Out of these three, one may have had a rough L-R concept before beginning training

(J.R. began the week with a perfect score of 10 on the Arrows Test), and one (Allen, 1972) did poorly on the training task. Performance on the original training task was below expectations in each study.

The present study failed to adequately train all of the Ss on the L-R discrimination task, making the issue of conservation (transference) somewhat premature. One is tempted to try to explain the results away on the basis of a maturational argument i.e. those Ss who could not learn the original L-R task and/or the transfer tasks, were simply too developmentally immature. "The objection that the apparent 'age of emergence' is dependent on the specific experimental procedures utilized does not pose insuperable difficulties for the concept of 'levels'. This objection does, however, suffice to demonstrate that any stated 'age of emergence' must be arbitrary until the effects of all relevant variables have been systematically explored, so that extraneous factors . . . which may hinder the younger Ss from responding to the relevant cues . . . are identified and eliminated." (Braine, 1968, p. 191) As Braine states, it is necessary to examine all potentially relevant variables rather than using maturational level as a total solution.

In a critique of the numerous failures in research designed to teach early concepts, Sigel (1964) observed that "possibly they did not employ sufficiently long training periods nor ascertain with any precision the necessary sequences as preludes to learning." (p. 240) These criticisms would seem to apply to the present study, in particular to the lack of precise pretested learning sequences.

Reviewing the data on the training task, it becomes apparent that P_1 through P_4 presented few consistent difficulties for the Ss. However P_5 and P_6--where the visual cues were eliminated--presented difficulties for most of the Ss, leading perhaps to an incomplete acquisition of the discrimination of L-R within the training paradigm. Apparently for most of the Ss, the switch from P_4 (dim light) to P_5 (no lights) was too large a change. The light seems to have become the controlling stimulus (Honig, 1966) rather than the lateral placement of the panels. The original aim was that by gradual fading, the laterality would become the controlling stimulus. "Most subjects, normal and pathological, perform on the same level, whether their eyes are open or closed; in other words, independently of whether their identifications are visually directed." (Benton,

1968, p. 749) It appears then, that the training task placed control in a stimulus dimension which is minimally used in the normal development of L-R discrimination. The training thus did not serve to parallel (with acceleration) normal L-R development. There was insufficient consideration of the possible effects of the order of the fading of the training cues. The children's performance demonstrates this.

The phase changes from P_4 to P_5 were too large step changes as is apparent from the number of errors made at P_5. Most of the subjects were unable to move from the light as the controlling stimulus (P_4) to laterality as the controlling stimulus (P_5). The subjects' own statements illustrate the shortcomings of the training procedure.

Looking at the phenomenological inquiry data, J.R. was the only subject to demonstrate verbal comprehension of the relationship of the verbal cues ("left" and "right") to the proper lateral cues, following the final training session. B.D. seemed to have some idea of the procedure, although his performance as well as his verbalizations demonstrated that he did not fully grasp the task after five training sessions. The other Ss seemed to be attending more to the reinforcers (the M & M's) than to the task. Perhaps the

substitution of marbles or tokens which could be traded in later (as could the M & M's) would have improved attention to the task. However there appeared to be an interaction between task difficulty and inattention. The increased difficulty of P_5 and P_6 appeared to increase the childrens' lack of attention.

Benton (1968) and Kephart (cited in Phillips, 1969) stress proprioceptive and perceptual-motor cues as the basis for the development of L-R discrimination. It should be noted that J.R. used his body in a very overt way to orient himself to L-R on the Arrows Test. This suggests that perhaps the ordering of the phases should have been different, with P_1 (tactile) being the last cue to be faded out--and in a more gradual manner than was done. Another possible means of increasing these proprioceptive and perceptual-motor cues, might have been to begin by placing the "push panels" so far apart that the child had to physically turn his body to push the panels. The distance between the panels could then have been gradually brought closer together. This might have put increased stimulus control in lateral cues and increased learning as well as transference. Allen (1972) suggested the possibility that different children are more sensitive to different sensory modalities

(and hence different cues) on an individualized basis. All of these possible variations of the stimulus dimension and the order of fading should have been explored more systematically in pilot assessments. They now remain to be explored in future research.

Since the present investigation was not able to adequately teach the basic L-R discrimination task (substage 1A), a complete analysis of the problem of task conservation on criterion tasks is somewhat premature. However the basic questions remain as to whether, given training in L-R discrimination, conservation can be expected without specific exposure to the new stimulus situations. This question warrants at least a preliminary consideration of some of the dimensions of this problem.

Sigel, Saltz and Roskind (1967) conclude that the emergence of conservation is a maturational development of the ability to tolerate irrelevant stimulation, and to focus on the central stimuli. If Sigel et al. are correct, no amount of training should lead to transference. However the literature on transference of training suggests several factors which might help foster the conservation of a concept such as L-R.

"Children have narrow concepts which are disrupted by stimulus alteration." (Sigel, Saltz & Roskind, 1967) The greater the number of irrelevant dimensions the child must attend to, the greater the transference difficulties (Lipsitt & Eimas, 1972). In the design of the present study, the attempt was made to narrow the child's attention to only a single stimulus dimension--laterality. Presumably this would increase the chances of positive transference occurring. The previously suggested design changes in the training task are aimed at narrowing the child's attention even further. Presumably this might have some carryover to the transference tasks (which were based on a concept of laterality having been acquired).

Additionally as Sigel (1964) pointed out, insufficiently long training periods hamper concept training. Similarly, it is known that overlearning assists transfer of training by helping the subject to ignore irrelevant stimulus dimensions. Therefore both to assist initial L-R concept acquisition and performance on the criterion tasks, increased training trials should be attempted. Given improvements in the methodology, an increase in the child's exposure to the training task might facilitate transference.

Positive transfer of training is fostered by holding response variables constant and changing the stimuli (Bruce, 1933). The criterion tests (L-R SELF, Arrows, and L-R OTHER) required different responses than did the training task. The Arrows test could easily be changed to require the same response as the training task, i.e. "Push the correct button and say if the arrow is pointing to the left or to the right.". L-R SELF and L-R OTHER are less amenable to such a change. However the contribution of response similarity would become more obvious were L-R SELF and OTHER contrasted with the redesigned Arrows test.

The teaching of a general principle facilitates transfer (Judd, 1908; Andrews & Cronbach, 1966). "Transfer of a previously acquired behavior-pattern to a new situation will occur whenever an individual recognizes the new situation as similar to the situation for which the behavior was learned." (Andrews & Cronbach, 1966, p. 548) Given these principles, perhaps a general statement relating the training task to the criterion tasks would help establish a set conducive to conservation.

The aforementioned transfer of training variables offer several dimensions which can be manipulated to help produce conservation of L-R concepts. Further research is

needed to help determine to what degree conservation of L-R concepts are subject to training. Precisely how much "guidance" and directed training the child of four needs in order to be able to generalize L-R concepts to a new situation remains to be demonstrated.

It is apparent that a great deal of normative longitudinal data in the area of L-R concept development is needed. Were more of the naturally occurring antecedents of L-R development known, more effective methods of teaching the concept (including the conservation of the concept) might become possible. Additionally, the precise relationship of several suggested important correlates of L-R conceptualization to future development, remain to be explored in a large scale normative study. Among these correlates are handedness (Benton, 1959; 1968), I.Q. (particularly PIQ--see Belmont & Birch, 1968), reading development, and neuropsychological development in general. Longitudinal research, such as the research program of Satz (Satz & Friel, 1972a; Satz & Van Nostrand, 1972) are indicative of the type of research necessary to more adequately describe a child's developmental pattern.

Methodological and design problems make it difficult to draw clearcut conclusions from the present study. However

there is some evidence (Jeffrey, 1958; as well as two Ss in the present study and one pilot S) that L-R discrimination (substage 1A) can be taught to children who are below the usual age for concept acquisition. Additionally, J.R. was able to show conservation of a L-R concept (substage 1B), as was one pilot S and one of Allen's Ss. Methodological modifications both in the training procedure for the basic L-R concept, as well as modifications of the transfer task dimension should increase the likelihood of more consistently teaching young children a substage 1B L-R concept.

APPENDIX A

L-R SELF:

"Point to your . . . ."

1. right ear
2. nose
3. left eye
4. left leg
5. mouth
6. right eye
7. left hand
8. right leg
9. head
10. right hand
11. left ear
12. neck
13. right eye
14. stomach
15. left leg

APPENDIX B

L-R OTHER:

"Point to my . . . ."

1. Stomach
2. left ear
3. right hand
4. left eye
5. nose
6. left leg
7. mouth
8. right eye
9. right ear
10. left hand
11. neck
12. right hand
13. right leg
14. head
15. left leg

NOTES

[1]Benton, 1959; Laurendeau & Pinard, 1970

[2]Laurendeau & Pinard, 1970; Benton, 1959

[3]Benton, 1959

[4]Benton, 1959; Laurendeau & Pinard, 1970

[5]Piaget, 1928; Laurendeau & Pinard, 1970

[6]Shemyakin, 1959

[7]Shemyakin, 1959

[8]Laurendeau & Pinard, 1970

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BIOGRAPHICAL SKETCH

Howard Mark Schulman was born January 7, 1948 in New York, New York. He attended public schools in New York City and graduated from Thomas Jefferson High School, Brooklyn, New York, in June of 1964. He attended Brooklyn College, Brooklyn, New York and was a recipient of a New York State Regent's Scholarship and a Generoso Pope Scholarship. In June of 1968 he received a Bachelor of Arts degree, Cum Laude With Honors in Psychology.

He entered the graduate program in clinical psychology at the University of Florida in September, 1968. While pursuing his studies at the University of Florida he has been supported as a United States Public Health Service Trainee, a Psychology Department Teaching Assistant and as a Veterans Administration Psychology Trainee.

In December of 1971 he received the Master of Arts degree in psychology from the University of Florida.

Mr. Schulman completed a one year internship in clinical psychology at Area C Community Mental Health Center in Washington, D.C. in September, 1973.

Since October, 1973 he has been employed as Staff Clinical Psychologist with the Department of Social and Preventive Medicine of the University of Maryland in Baltimore.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Paul Satz, Chairman
Professor of Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Hugh C. Davis
Professor of Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

William D. Wolking
Professor of Special Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Anastasia Wells

Anastasia Wells
Assistant Professor of
Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Victor A. Thompson for
Bert E. Swanson

Bert E. Swanson
Professor of Political Science

This dissertation was submitted to the Graduate Faculty of the Department of Psychology in the College of Arts and Sciences and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

June, 1974

Dean, Graduate School