The effects of movement and haptic exploration on paired-associate learning in overactive boys.

THE EFFECTS OF MOVEMENT AND HAPTIC EXPLORATION ON PAIRED-ASSOCIATE LEARNING IN OVERACTIVE BOYS

A Dissertation Presented

by

PAMELA CALVERT

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ABSTRACT

The Effects of Movement and Haptic Exploration
on Paired Associate Learning in Overactive Boys

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Bodily movement, haptic exploration, and self-pacing may enhance learning in younger children and in older overactive children. This study compared 36 younger boys (aged 4 and 5) and 36 older boys (aged 8 and 9) rated as overactive or underactive by their teachers. Immediate and delayed memory (after 15 minutes) were tested after 5 learning conditions: 1) visual exposure for 7 seconds, 2) visual exposure for 14 seconds, 3) haptic + visual exposure for 7 seconds, 4) haptic + visual, self-paced, and 5) movement + haptic + visual, self-paced. Ss were exposed successively to pairs of toys hidden under plastic cups (10 pair for younger Ss and 15 for older) and asked to remember which toy went with which. Toy pairs and conditions were counterbalanced. In the movement condition Ss walked from pair to pair; in others they sat at a table. As predicted, younger Ss and older overactive Ss remembered significantly more object pairs after the movement and haptic conditions than after visual conditions. Older overactives performed better than older underactives after the movement and self-paced haptic conditions. Self-pacing improved learning in older overactives but not in older underactives who did better in the haptic-timed condition. There were no significant differences in memory between long and short visual conditions, between immediate and delayed memory, not between younger overactive and underactive boys in any condition. It was concluded that in some learning tasks, many young school-aged boys may still need to move around and manipulate objects at their own pace in order to learn effectively.

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CHAPTER I

INTRODUCTION

The major purpose of this study is to appraise the relationship between attention, memory and bodily movement in 4- and 5-year-old and 8- and 9-year-old boys rated by their teachers as overactive or underactive. Attention has been studied in normal and special populations (Hagen & Hale, 1973; Douglas, 1972, 1974), and the effects of motor activity on attention have been studied in normal children (Daehler, 1971, Levin, McCabe & Bender, 1975), but there has been no attempt to use bodily movement in space by the child himself as an experimental variable in relation to differences in learning efficiency in children with different activity levels. The major goal of the present study is to investigate the possibility that children labeled as overactive might benefit from learning experiences which involve movement.

The specific objective of the study is to compare the immediate and delayed memory of children of low and high activity levels, using visual and haptic cues in the presence or absence of movement and self-pacing of the learning task. In addition to the effects of activity levels on learning, developmental differences between the younger and older children will be examined. The effects of self-pacing on learning will be studied in a haptic learning task and a learning task involving both movement and haptic exploration. Self-pacing has been found to facilitate learning in normal children (Flavell, Freidrichs, & Holt, 1970) and in hyperactive children (Sykes, Douglas, & Morgenstern, 1973).

There is agreement among the advocates of movement education that motor involvement can facilitate learning. This attitude is well illustrated by Flinchum:

> Since moving is central to children's total growth and development, it should be recognized that while children are indeed learning to move for movement's sake, they are also learning through movement for learning's sake (1975, p. 316).

The second half of Flinchum's statement has not been supported by empirical data. The emphasis within the motor/movement literature has been based on the assumption that development of fine and gross motor skills will benefit learning in general. The present study is based on the assumption that motor activity may have an important influence on attending and remembering, particularly in preschool children and highly active school-aged children.

It is important to examine the effect of movement and haptic exploration on learning in the light of the theory of Piaget (1952) that thought is based on activity patterns, and the experimental work of Zaporozhets (1965, 1971) which indicates that haptic learning develops earlier than purely visual learning.

Because the inability to sustain attention is one of the most serious symptoms of hyperactive children (Ross & Ross, 1976; Douglas & Peters, 1979), investigation of the effectiveness of the various conditions for teaching a simple memory task to these children could well provide evidence on which more effective teaching methods could be based.

CHAPTER II

REVIEW OF THE LITERATURE

The inability to sustain attention is the major educational problem of hyperactive children. When classroom behavior is considered, the factor which consistently differentiates hyperactives from normals is their lower level of attention to the assigned task. The American Psychiatric Association has, in fact, recently replaced the diagnostic category of "hyperkinetic reaction" by a category called "attention deficit disorder." In the review which follows, theories of attention will be considered in relation to the question of the attentional deficit accompanying hyperactivity. Then, both historical precedent and practical justification will be given for using short-term memory tasks as criteria for evaluating attention in children, and studies employing short-term memory in both normal and hyperactive children will be cited.

Selective Attention

Broadbent has been credited with the development of the first major theory of attention (Swets & Kristofferson, 1970). His explanation of selective attention is based on a filter theory, in which he postulates that a filtering process occurs between the sensory stage and the perceptual stage and allows only one stimulus at a time to be perceived (Broadbent, 1958). The filter blocks undesired inputs and allows only one stimulus at a time into the perceptual system. Several other theorists have supported the idea of a filter but with their own adaptations.

Moray (1959) and Deutsch and Deutsch (1961) felt that the filter should be more properly placed _after_ the perceptual analysis and before the response selection. Triesman (1969) proposed both an early filter based on physical characteristics of the stimulus and a later filter based on meaning.

Rejecting the filter approach, Kahneman (1973) and Norman and Bobrow (1975) proposed _capacity_ theories. The model proposed by Kahneman is based on a "general limit on man's capacity to perform mental work" and on an allocation policy for dividing attention. Norman and Bobrow also supported the idea of a capacity theory of selective attention and introduced the terminology of top-down and bottom-up processing. These terms describe information processing in the direction of central to peripheral or vice versa.

Neisser proposed a third approach to the issue of selective attention (1967, 1976). He called his explanation _analysis-by-synthesis_ and described the process as follows:

> The course of synthesis is partly determined by stimulus information, but it also depends on such factors as past experience, expectation, and preference. These nonstimulus variables play a dual role, since they influence the choice of one figure rather than another for attention as well as the details of the construction which takes place (1967, p. 301).

Neisser's explanation demonstrates the complexity of describing attention in the information processing system. Like Triesman, his view of selective attention is based on stimulus properties and stimulus meaning which is based on the effects of past experience on mental structure.

Attentional Deficit

The precise nature of an attentional deficit may be explained differently by the different models of attention. If a filter approach is accepted, the filter mechanism of a hyperactive child would be considered to be impaired and therefore unable to do the necessary screening, and the result would be overstimulation. This explanation of the attentional deficit of hyperactive children was accepted for some time. Even before the idea of a filter was introduced, Strauss and Lentinen (1947) proposed the theory that hyperactive children were subject to sensory overload. Cruikshank (1961) supported their lead by proposing stimulus reduction as a remediation technique. His conclusions were not supported by empirical research, and many researchers now reject the idea of a defective filter in hyperactive children. Douglas and Peters (1974), for example, have pointed out that these children may need <u>more</u> and <u>not less</u> stimulation, that their hyperactivity may be a way of increasing stimulus input to an optimal level.

For attention to be defective in the capacity model, either the arousal mechanism or the allocation policy might be inadequate for the task demands. Since stimulants have been found to increase the attention of many hyperactive children (Conners, 1969), it is feasible to imagine that the deficit might be in the area of arousal. The concept of both top-down and bottom-up processing means that the deficit cannot be isolated at the sensory level but might easily be located centrally.

Neisser's analysis-by-synthesis theory would imply that the defect in attention might be the result of faulty memory, poor planning, or inadequate processing at any level. His explanations have been accepted by important reviewers in the fields of memory and attention (Hagen, 1972; Gibson & Rader, 1979).

Sustained Attention

When researchers and educators describe attentional deficits in hyperactive children, they are sometimes referring to selective attention (or the ability to focus on one stimulus) or they may be referring to attention span (or how long the attention to one stimulus or task persists). Peters (1977) concluded that sustained attention or attention span is a greater problem for hyperactive children.

The question of sustained attention has been approached in three ways: by measuring time on task, by measuring vigilance, and by measuring physiological processes believed to be associated with attention. During the late twenties and early thirties, several researchers timed young children's involvement with certain activities or toys (Bridges, 1929; Van Alstyne, 1932; Miles, 1933; Schacter, 1933). These studies showed an increase in time spent on various tasks as a result of development and in relation to the complexity and possibility of varied activities with the materials used.

In contrast to the measures of attention span are the measures of vigilance. A vigilance experiment is described by Moray as:

> a situation where nothing much is happening, but the observer is paying attention in the hope of detecting some event whenever it does happen (watch keeping) (1969, p. 6).

In other words, vigilance involves intermittent signal detection over time. The experiments on vigilance were first done with adults (usually in a military or industrial setting) to determine the factors that influence decreasing attentional efficiency over time (Peters, 1977).

Infant attention and memory have been measured by determining preferences (using paired comparisons) and by measuring response to novelty using the habituation/dishabituation paradigm. Measures of eye movements, changes in heart rate and evoked potentials have also been used to infer attention. (The heart rate decelerates when the infant appears to be attending to a stimulus, one of the indications of the orienting response.) Cohen (1973) has hypothesized from this research that there are two processes operating: attention-getting and attention holding. Attention-getting would involve the orienting response or arousal (based largely on stimulus intensity or novelty) and attention-holding would involve the cognitive processing of the stimulus (based on stimulus pattern, complexity, and meaning).

Attentional Deficit in Hyperactive Children

In the research done in the thirties, individual differences in attention were found to be related to age and sex. During the preschool period, attention span increases with age, and preschool boys choose more active materials to play with than girls do (Van Alstyne, 1932). One might assume that the sex differences found in attention are related to sex differences in activity level in general, since boys are more active than girls (Maccoby & Jaklin, 1974), and hyperactivity is more prevalent in boys. The range of estimated prevalence of hyperactivity is from 2.5 boys to every girl up to 9 boys for every girl, with the most common ratio given as 5 boys to 1 girl (Stewart & Olds, 1973).

Boys have been observed to be more active than girls and to show attentional differences from early infancy. Cohen, Gelber, and Lazar (1971) observed 3½-month-old boys to habituate more rapidly to visual stimuli and to respond to change to a novel stimulus more than girls did. Lewis, Goldberg, and Campbell (1969) and Kagan (1971) also observed infant boys to habituate to visual stimuli more rapidly than girls did. Collard (1982) observed 10-12-month-old boys to change schemas with an object more frequently than girls did and to habituate more rapidly in their play with the object. Goldberg and Lewis (1969) found that year-old boys moved through space more and contacted more objects per unit time than girls did.

The relationship of activity level to learning has not been specifically studied in infancy, possibly because it is not known which infants will develop into hyperactive children (Rapoport, Quinn, Burg, & Bartley, 1979). Also, difficult infants who later prove to be hyperactive may have been dropped from the studies because of their inability to cooperate with the experimenters.

In vigilance tasks, the performance of hyperactive children was found by Sykes et al (1973) to deteriorate over time. Other studies have shown that hyperactives perform worse than other children on vigilance tasks (Anderson, Halcomb, & Doyle, 1973). Douglas (1974) concluded from all the evidence that <u>one of the fundamental difficulties of hyperactive children is their inability to sustain attention</u>.

Schachar, Rutter, and Smith (1981) were puzzled by the difference in percentage of diagnosis of hyperactivity in the United States (40% of the children referred to child guidance clinics) and England (two percent). This discrepancy led them to distinguish between <u>true hyperactives</u> who are consistently overactive and <u>situational hyperactives</u> who are only overactive in boring, other-directed movement-restricted tasks which are not self-paced.

Arousal Level in Hyperactive Children

Hyperactives are believed to have lower arousal levels than normals, because their ability to focus on tasks and their vigilance increase when they are placed on stimulant medication, and their performance also improves when they are receiving continuous moderate reinforcement. Both stimulant drugs and reinforcement increase arousal level.

Hyperactive children may not differ from normals on basal autonomic measures of arousal, but compared to normals they tend to show diminished responses to relevant stimuli in a learning task (Hastings & Barkley, 1978). For example, in a delayed reaction time task, Cohen and Douglas (1972) found no difference between hyperactives and normals in resting skin conductance nor did they find a difference in onset and habituation of skin conductance for nonsignal stimuli; however, the hyperactive subjects showed significantly lower skin conductance (i.e., a lower orienting response) to the signal stimuli in the task than normals did. These results (which were replicated by Firestone and Douglas in 1975) led them to conclude that hyperactive children may have difficulty modulating their arousal level in terms of specific task demands.

Continuous reward increases the performance of hyperactives on a vigilance task, but not as much as in normals. Also, if the rewards are highly stimulating, they may push the hyperactives to a higher than optimal arousal level and lead to more impulsive responding (Firestone and Douglas, 1975). It may be that hyperactives shift readily from a too low to a too high arousal level, and the extreme lability of their arousal level makes them less capable of modulating activation to meet task demands. They are not as able as normals are in mobilizing task appropriate arousal or in inhibiting task irrelevant responding.

The theory that hyperactives have lower than normal arousal levels was proposed by Farley (1974). He based his theory on slow EEG activities and other physiological indicators that have been found to be consistent with some hyperactives. His theory states that the lower arousal level exhibited by these children results in more stimulation-seeking behavior than in their normal peers.

Farley also considered the effect that amphetamines have on the behavior of some hyperactives. He proposed that in an effort to achieve a more optimal level of internal arousal, hyperactive (low arousal) children continually seek higher levels of stimulation from their environments. Since this stimulation-seeking behavior tends to moderate and attention is improved with amphetamines, medicated hyperactives may be seen as having a heightened arousal level and behavior that is more age and place appropriate.

Zentall and Zentall (1975, 1976) attempted to explain the various effects amphetamines have on hyperactive children. They stated that

> If arousal is initially relatively low then amphetamine will tend to heighten it; if arousal is relatively high then amphetamine will tend to depress it (Zentall and Zentall, 1976, p. 188).

Their conclusions are consistent with Farley's theory that at least some hyperactives are underaroused and extend the continuum to include hyperactives at the other extreme who may be overaroused.

Attention and Memory

An indirect way of measuring attention in children is to give them memory tasks and to infer their level of attention by how well they perform on the tasks. The administration of short-term memory tasks is relatively simple and can be applied to a wide age range.

Using memory tasks to assess attention has been well established. William James (1890) recognized the connection when he stated that one of the effects of attention is to make us remember. Three principal types of tasks have been used during the past two decades to measure attention: serial recall tasks, central/incidental task paradigms, and paired-associate learning paradigms.

The Serial Recall Task

Atkinson, Hansen, and Bernback (1964) established the feasibility of using short-term memory tasks as criteria for evaluating attention by devising a technique specifically designed to sustain the attention of a young child: the serial order recall task. In this procedure, several cards with different stimuli printed on them are presented face down in a horizontal array. Each card is shown briefly and turned over again. The child is then asked to recall which card matches a cue card within the array. This task has been repeated with variations by a number of researchers (Flavell, Beach, & Chinsky, 1966; Keeney, Cannizzo, & Flavell, 1967; Hagen & Kingsley, 1968; Kingsley & Hagen, 1969; Hagen & Kail, 1973).

The primary finding from the research using serial recall tasks is that memory increases with age. Atkinson, et al (1964) also reported that response latencies for the correct responses were faster than those for the errors. Several of the studies which followed were focused on the subjects' use of the strategy of spontaneous verbal rehearsal to facilitate memory (Flavell, et al, 1966; Keeney, et al, 1967; Hagen & Kingsley, 1968; Kingsley & Hagen, 1969).

Flavell and associates first looked at two alternative hypotheses regarding verbally mediated performance (1966). The first of these hypotheses is that younger children have a deficiency in verbal mediation. While they are able to understand and use the words correctly, there is a stage in which young children do not use this skill to mediate or regulate their behavior. The second hypothesis is that the verbal response is simply not made by these children in nonverbal tasks. The first possibility is characterized as a "mediational-deficiency" hypothesis, while the second is described as a "production-deficiency" hypothesis. Flavell, et al tested the mediation hypothesis with 5-, 7- and 10-year-old children. During the delay period between presentation and recall, the children were observed moving their lips. The younger children named or rehearsed only two times out of 20, while the middle age group rehearsed in 12 out of 20 instances, and the older group did so in 17 out of 20 instances. The verbal rehearsal was positively related to success on the recall task. Flavell, et al believed that their results indicated a production deficiency rather than a mediation deficiency in the younger children.

Keeney, et al (1967) replicated the study just described and found that when 6- and 7-year-olds were taught to rehearse, their recall improved to the level of those who spontaneously rehearsed. This result supported the production deficiency hypothesis since the former children were simply not using a skill they were capable of using.

Hagen and Kingsley (1968) expanded the age groups from these earlier studies to range from nursery school to grade 5. Using a serial position task, they found that overt labeling was facilitating for those in the middle age range but not for the youngest and oldest children. They concluded that there may be an optimal period within which labeling facilitates memory. They considered their results compatible with the mediation deficiency hypothesis and concluded that:

> Labeling did not help the youngest children....The youngest Ss overtly verbalized, but the labels did not mediate recall. At age 6, however, mediation occurred, and overt verbalization facilitated it. By age 10, when mediation is a relatively automatic and covert process, overt verbalization did not facilitate overall recall (Hagen & Kingsley, 1968, p. 119).

Major findings of a study with nursery school children (Kingsley & Hagen, 1969) were that rehearsal of the labels was facilitating to recall on early serial items, and overt labeling aided recall on the last serial item. They also found that verbal rehearsal is not used spontaneously by young children.

Hagen and Kail (1973) used a serial-position recall task with 7- and 11-year-old children. Their study included a study condition and a distracting condition along with the use of a standard serial task as a control. In the control condition, results indicated that recall improved with age. In the study period condition, recall improved for only the older children. In the distracting condition, recall declined in both groups; the results for the older children were very similar to results for the younger ones. Hagen and Kail concluded that "children in the 7-year age range do not yet characteristically engage in rehearsal to improve recall, but by 11 years children are proficient in using this strategy" (1973, p. 835).

The following statements provide a summary of the conclusions from the studies using serial recall tasks:

1. Short-term memory improves with age.
2. Children younger than 5 might be described as having a mediational deficiency. Verbal labeling was not found to be facilitating with young children.
3. Children from 5 to 7 might be described as having a production deficiency. They do not spontaneously use a skill they are capable of using.
4. Strategies such as verbal rehearsal are present in 10- and 11-year-old children.

Central/Incidental Learning Tasks

Maccoby and Hagen (1965) adapted the serial recall task and introduced the use of the central/incidental task paradigm. Their study was based on Broadbent's filter model, and they assumed that young children were less able to shut out stimuli irrelevant to the central task (in other words, that younger children are more easily distracted than older children). The procedure used was the presentation of variously colored cards whose colors were to be remembered as the central task. The cards had figures on them which were to be remembered as the incidental task. The children were told to look at both the pictures and the colors but that only the colors were to be recalled later. Four, five, or six cards were displayed at a time for about five seconds. The cards were left face down on the table, and the child was asked to pick out the card that matched a color chip shown by the experimenter. After all the central trials, the subjects were asked to recall which picture out of six had been presented earlier.

The children's performance on the central learning task was found to improve with age, while performance on the incidental learning task did not improve with age but instead showed a decline in the oldest subjects. The older children (10-12 year old) who didwell on the central task seemed to ignore the incidental information.

Many variations of the central/incidental paradigm have been used by Hagen and others (Hagen, 1967; Druker & Hagen, 1969; Hagen, Meacham & Mesibov, 1970; Sabo & Hagen, 1973; Casey, 1976; Conroy & Weener, 1976).

Hagen and his associates continued to use the central/incidental paradigm. In his first follow-up study, Hagen adapted the original design by replacing the color and object combination with cards containing two classes of objects, household objects and animals (1967). He also found that central task performance improved with age, while the proportion of incidental material to total material remembered decreased with age. His conclusion was that older children are more proficient than younger ones at excluding irrelevant information.

After giving the central and incidental task, Druker and Hagen (1969) administered a questionnaire which indicated that visual scanning and verbal labeling increased with age. Hagen, Meacham, and Mesibov found that spontaneous labeling seems to disrupt rehearsal strategy for children under age 10 (1970). In Sabo and Hagen's study of the effect of rehearsal (1973), older children (age 12) were found to improve their performance on the central task when additional rehearsal time was allowed.

From all these studies, Hagen (1972) developed a cognitive strategy hypothesis. He concluded that cognitive strategy is the developing skill which allows older children to perform better on memory tasks than younger ones do. Because he found that short-term memory involves intention, verbal processes, and cognitive strategies, he shifted from focusing on the theory of a filter system and distractability to a view more compatible with Neisser's model of attention.

Other researchers have tested Hagen's hypothesis and asked additional questions within the central/incidental task paradigm. Flavell and his associates (1970) concluded that the strategies developing in the memorization process were naming, anticipating, and rehearsing. Casey (1976) found if the subjects were told what to remember, they learned the central task faster. She also observed that children who learned slowly on the central task did better on the incidental task than fast or intermediate learners. Conroy and Weener (1976) also observed the age differences identified by Hagen, and they found, in addition, that immediate probes produced better results than delayed probes. They found no main effects involving the modality of presentation (visual or auditory).

The principal conclusions from the central/incidental learning studies are the following:

1. Older children are better able to ignore irrelevant information.
2. Older children are better able to employ cognitive skills in order to concentrate exclusively on task-relevant information.
3. Learning strategies used by older children are disrupted when additional cognitive demands are introduced during acquisition.

Paired-Associate Learning Tasks

The paired-associate paradigm is the third major type of study used to assess attention through memory. Peterson and Peterson (1962) introduced this method of study with adult subjects. These tasks involve remembering the association between pairs of objects, pictures, or words. Typically, a number of pairs are presented to the subject for a brief time. Then the subject is presented with one member of the pair and is asked to remember the related item. Paired-associate learning tasks have been used in a variety of ways by a significant number of researchers (Milgram, 1967; Wolff & Levin, 1972; Wolff, Levin & Longobardi, 1972, 1974; Levin, Davidson, Wolff & Citron, 1973; McCabe, Levin & Wolff, 1974; Varley, Levin, Severson & Wolff, 1974; Levin, McCabe & Bender, 1975).

Several of these studies included teaching the children to state the relationship of the pair of items in a sentence as a learning strategy. Milgram (1967) found that both normal and retarded subjects benefited from the sentence strategy, but that only the normals retained the skill after one week. Levin, et al (1973) used imagery generation in addition to sentence generation as strategies. They found that children 7-years or older could benefit from either strategy but that a combined strategy did not help more than either of them used separately.

McCabe, et al (1974) included tactual manipulation as a condition and found that sentence making combined with manipulation of toys was not significantly different from sentence making alone. However, the preschool-aged subjects performed better in the manipulation condition than they did in the other conditions.

Other studies have also used motor activity with or without manipulation of toys as a variable (Levin, et al, 1975; Wolff, et al, 1972, 1974; Wolff & Levin, 1972; Varley, et al, 1974). The major conclusions from these studies are the following:

1. Children's ability to use imagery as a learning strategy develops between the ages of 5 and 7.
2. Motor activity with objects facilitates learning in younger children more than in older children.
3. Training in motor activity with test objects facilitates learning in 5-year-olds more than imagery training does. Six-year-old girls benefit equally from both types of training, while training in motor activity remains more facilitating for 6-year-old boys.
4. The strategy of sentence production acts as a facilitator earlier than imagery generation does.

Learning Studies with Hyperactive Children

Many of the learning tasks used to assess attention in normal children have also been used with hyperactive children. In a review of the studies on hyperactive children, Douglas and Peters (1979) arrived at two main conclusions. The first conclusion is that the major attentional deficit in hyperactive children is in their ability to sustain attention. The second conclusion is that distractibility is not the major problem of hyperactive children, although it may occur in some.

Research studies support these conclusions. Douglas (1972) found that hyperactives did not differ from normal controls in tasks requiring brief periods of attention. In a study using testing sessions lasting two and one/half hours, the deterioration of the performance of hyperactives compared to normals could be seen as arising from a sustained attention deficit (Worland, North-Jones & Stern, 1973). In a study of assessment measures by Homatidis and Konstantareas (1981), all the measures with the exception of self-concept that discriminated hyperactives from normals involved some aspect of attention. As a result of these research studies, the terminology used to describe these children is changing. Loney (1980) describes this change as "a shift in focus from hyperactivity to inattention," and, as mentioned previously, the American Psychiatric Association has changed the diagnostic category for these children from "hyperkinetic" to "attention deficit."

Examples of studies which support the conclusion that distractibility is not a major problem of hyperactive children are many. Bremer and Stern (1976) found that hyperactives performed as well as normals in a reading task with distractions. In a study by Zentall and Zentall (1976) a situation low in stimulation led to overactive behavior in hyperactive children. In a central/incidental learning task, Peters (1977) found that hyperactives did not differ from normals in incidental learning performance. According to Peters, their learning is not more influenced by stimuli irrelevant to the learning task, although they may attend to them more than normals do.

In addition to these major conclusions, there are two findings that are particularly relevant to the present study. One is that in arbitrary paired-associate tasks, hyperactive children perform poorly and display an inability to use effective learning strategies (Benezra, 1978, reported by Douglas and Peters, 1979). The other is the finding that when hyperactives are presented with a variety of tasks, they perform better on <u>self-paced</u> tasks than on experimenter-paced tasks (Sykes, Douglas & Morgenstern, 1973).

To summarize the conclusions from the studies on learning in hyperactive children:

1. The inability to sustain attention is the major attentional problem of hyperactive children.
2. Distractions during learning tasks are no more disabling for hyperactives than for normal controls.
3. Hyperactive children display less effective use of cognitive strategies in learning tasks than do their normal peers.
4. Hyperactive children benefit from conditions which allow self-pacing.

CHAPTER III

METHOD

Purpose of the Present Study

The purpose of the present study was to investigate some of the factors which might improve learning in overactive children. To do this, groups of younger and older overactive and underactive children were given a series of paired-associate learning tasks under different conditions, and their learning efficiency under these conditions could then be measured and compared. The method of paired-associate learning was chosen, because Benezra (1978) observed hyperactive children to perform more poorly on these tasks than normal children did; therefore, these tasks would provide a baseline which might show the effects of varying experimental conditions on this type of learning. In the present study, learning efficiency in paired-associate tasks were compared under five conditions:

1. visual memory, short exposure (7 seconds)
2. visual memory, long exposure (14 seconds)
3. haptic + visual, timed (7 seconds)
4. haptic + visual, self-paced
5. movement + visual + haptic + self-paced.

The self-paced conditions were used, because Sykes et al (1973) found that self-pacing improved the performance of hyperactive children in a variety of learning tasks. Tasks involving the visual modality alone and tasks involving haptic + visual modalities were used, because

Wolff, Levin, & Lombardi (1972, 1974) found that manipulation facilitated kindergarten children's performance on paired-associate learning tasks. A movement condition was used, because it may be true that overactive children use movement to increase their stimulation level as well as to reduce tension which might interfere with learning. Because the primary deficit of hyperactive children may be in the area of sustained attention (Douglas & Peters, 1979), attention span was measured in the self-paced tasks. The length of time spent with each pair of objects could also be compared to success on the item.

Hypotheses

Hypotheses were that:

1. Both the overactive and underactive subjects in the younger sample would perform best in the movement condition.
2. The older overactive group would perform best in the movement condition.
3. The older underactive group would perform equally well in the visual and the movement conditions.
4. The younger children and the older overactive children would perform better in the haptic + visual condition than they would in the visual memory tasks.
5. Both the overactive and underactive subjects would perform better in the self-paced haptic task than in the timed haptic task.

Subjects

Seventy-two boys, 36 four- and five-year-olds and 36 eight- and nine-year-olds, took part in the study. Boys were studied, because in a pilot study, the teachers were found to rate only boys as overactive, and the majority of children rated as underactive were girls. Boys showing extremes of activity level in normal classrooms were chosen rather than boys clinically diagnosed as hyperactive so that the results of the study would apply to children in an average classroom. Because the sample size for some of the measures was small, it was felt that choosing subjects showing extreme levels of over- or underactivity would demonstrate more clearly the effect of activity level on learning under the various conditions used in the study.

A rating scale designed for this study was given to the children's teachers to identify boys who were more active and those who were less active than their classmates (see Appendix A). A rating scale was used rather than a short-term observational measure, because hyperactive children have been found by Abikoff, Gittelman, and Klein (1980) to show greater day-to-day within-subject variability of activity level than normals, which would make a short-term measure less accurate in identifying subjects than a rating scale used by a teacher familiar with the children over a period of months. In Sandoval's 1977 review of the measurement of hyperactivity, he suggests that rating scales should be used to rate an entire class rather than one child only, because most of the items concerned with hyperactivity consist of leading questions about symptoms which are negatively rather than positively stated. He also suggests that such a scale should contain items unrelated to hyperactivity as well as related items. The rating scale designed for the present study takes into account both of these suggestions. The scale allows the rater to select from behaviors along a continuum, and the teachers were asked to rate all the boys in the class, not just the overactive and underactive.

The low and high scorers on the rating scale were selected as subjects to be studied. The range of possible scores on the rating scale was 5 to 25. The cut-off scores chosen were 11 and 17; children scoring 11 and below were designated as "overactive" and those scoring 17 and above as "underactive." The younger subjects were selected from two elementary schools, one Headstart Center, and two daycare centers, all in the Western Massachusetts area. Eighteen overactive and 18 underactive younger subjects were selected from 58 children for whom the teachers completed the rating scale. The older subjects were selected from five elementary schools in Hampshire and Franklin Counties in Western Massachusetts. Eighteen overactive and 18 underactive subjects were selected from 53 boys rated by their teachers.

In summary, the four groups of 18 boys in the study were:

1. Younger overactive (aged 4 and 5)
2. Younger underactive (aged 4 and 5)
3. Older overactive (aged 8 and 9)
4. Older underactive (aged 8 and 9)

Materials

The objects used in the paired-associate learning tasks were 90 common small toys (for example, a toy boat, a hammer, and a rocking chair, varying in size from one to five inches in length). The 90 toys were randomly paired into 45 pairs and then into three sets of 15 pairs, as each child took part in three of the five learning conditions. The three sets of toys were counterbalanced within the five conditions and with the order of presentation for the various conditions. To make the task difficulty age appropriate, 15 pairs of toys were used with the older children for each learning task, while for the younger children only 10 pairs were used for each learning task (five toy pairs from each larger set were randomly eliminated). Between trials the pairs of toys were concealed under opaque blue plastic 16-ounce cups, four inches in diameter and five inches high.

Experimental Design and Procedure

Experimental Design

The following table summarizes the experimental design:

Table 1. Experimental Design

Condition	Time: Seconds Per Pair	Number of Subjects in Each Condition			
		Overactive		Underactive	
		younger	older	younger	older
1. $Visual_1$	7	9	9	9	9
2. $Visual_2$	14	9	9	9	9
3. $Haptic_1$	7	9	9	9	9
4. $Haptic_2$	variable	9	9	9	9
5. Movement	variable	18	18	18	18

In this design each subject served as his own control. Each child was given three out of the five conditions, each with an immediate memory test and a delayed memory test after 15 minutes. The administration time was approximately two hours for each child, including the delays. All subjects were given one of the two visual conditions, short or long, and each child received one of the two haptic conditions, timed or self-paced. The short and long visual conditions were given to determine the effect of time of exposure on visual learning and to allow a comparison between the visual and the self-paced haptic and movement conditions. Fourteen seconds was chosen for the long visual exposure, because it was the average time used by the children in the pilot study for the self-paced tasks. All of the children participated in the movement condition, because it was found in the pilot study that the highly active children performed best in this condition; therefore, the comparison of the overactive and underactive children on this test might be the most significant finding of the study.

Practice Trial

Each child was told that we would be playing some games to see how well he remembered. In the practice trial the child was seated at a small table with the experimenter at right angles to him. On the table were two plastic cups, each concealing a pair of toys. The experimenter removed one cup and showed the child one pair of toys (replaced the cup) and showed the child the other pair. Then one of each pair of toys was placed on the table with an additional toy not shown before. The other toy of each pair was then shown one at a time, and the child was asked to choose from the three toys on the table, "Which toy goes with this one?" If the child did not immediately understand the task, all the toys were rescrambled and the procedure repeated. All of the children given the practice trial appeared to understand the instructions.

General Procedure

For all conditions the general procedure was the same. The pairs of toys were hidden under opaque plastic cups which were arranged in the order of their presentation. The child could only look at or manipulate one pair of toys at a time; the others were out of sight under the cups. Under all the conditions the children were exposed successively to each pair of the set of 10 or 15 pairs of toys. Immediately afterward, the experimenter would place one toy of each of the pairs together on the table in front of the child. She would say, "I have given you half of the toys. I have the toys that they go with in my pail, and I will show them to you one at a time, and you can choose the one from your toys that goes with mine." (The toys were presented in a different order from the original presentation of the pairs of toys.) The experimenter would then place one of her toys on the table, and the child could choose which of his toys went with her toy by saying the name of the toy, by pointing to it, or by placing it beside the experimenter's toy. After the child had chosen which of his toys completed the pair, the experimenter replaced her toy back into the pail and the child's toy back into his group of toys on the table (always having the 10 or 15 toys grouped together before the child made a choice). After the test in each condition was completed, the experimenter said to the child, "Go back to the classroom for a few minutes, and I will call you back to see how well you remember these toys."

Visual conditions.--In the visual conditions, the toys were arranged on a table in pairs under the cups. The child was seated in a chair at right angles to the experimenter. The experimenter said to the child, "Look at each pair of toys for a few seconds and try to remember which toys go together. This time I want you only to look at the toys." In the short visual condition the cup was removed and each pair of toys was left uncovered for seven seconds and in the long visual condition for 14 seconds.

Timed haptic condition.--In this condition the toys were arranged on the table as in the visual condition. The experimenter told the child, "Play with the toys for a few seconds and remember that they go together." The child was then allowed to play with each pair of toys for seven seconds before he was asked which toys go together.

Self-paced haptic condition.--In this condition the toys were arranged on the table in pairs under the cups. The child was told, "This time you will uncover the toys yourself. I will tell you which ones to uncover next. After you play with the toys as long as you'd like, hand them to me."

Movement condition.--In this condition the standing child was given the same instructions as in the self-paced haptic condition. The pairs of toys under the cups were spaced in the room (on table, chairs, and floor about two and one-half feet apart), and the child could move about at his own pace from pair to pair to manipulate the pairs of toys sequentially.

Statistical Procedures

Analysis of the differences between the two younger groups and the two older groups and between the various learning conditions was made by using the Mann-Whitney U one-tailed test. This procedure was selected because of the relatively small sample and because the use of medians is preferable to the use of means if the data are skewed. A result was considered to be significant if its occurrence by chance was equal to or less than .05. The dependent variable to be compared is the score (number of correct pairings) for the various conditions by the two groups. An additional variable was the consideration of the element of time in relation to the score for the self-paced conditions. A contrast analysis of variance was done to show the interaction between the two older groups in the haptic conditions.

CHAPTER IV

RESULTS

Comparison of the Groups of Children

In general, memory for the pairs of objects was better for all of the children after the movement and haptic conditions than after the visual conditions (see Tables 2 and 3). The older overactive boys and the younger children appeared to profit most from the opportunity to move about and manipulate the test objects. The older overactive boys performed best in the delayed memory tests after the movement condition compared to the visual conditions ($p < .001$). Their memory was slightly better after the movement condition than after the haptic conditions, but these differences were not significant (see Tables 2 and 3). The performance of the combined groups of younger children was also best after the movement condition compared to the visual conditions ($p < .001$ in all comparisons except to the delayed memory tests after the long visual condition where $p < .005$).

In many of the visual learning tasks, the performance of the underactive children was about the same as their performance in the haptic and movement conditions, while this was not true of the overactive children. Many of these differences between conditions were nonsignificant in the underactive children but were significant in the overactive groups.

Both the younger and older overactive children performed better in the self-paced tasks (haptic and movement) compared to the timed tasks, while this was not true of the underactive subjects.

TABLE 2

COMPARISON OF IMMEDIATE AND DELAYED MEMORY AFTER DIFFERENT LEARNING CONDITIONS[a]

Conditions	Younger Children						Older Children			
	Overactive		Underactive		All Younger Ss[d]		Overactive		Underactive	
	Immediate	Delayed	Immediate	Delayed	Immediate	Delayed	Immediate	Delayed	Immediate	Delayed
Movement > visual short[c]	38.5**	32.5***	34.5***	47.0*	142.5*****	153.0*****	35.0***	18.5*****	40.5**	28.0***
Movement > visual long	33.5**	33.0***	51.5	59.0	163.5*****	185.5****	23.5***	19.0*****	62.5	44.0
Haptic self-paced > visual short	14.0***	13.0***	26.5	30.5	78.5***	85.5***	13.0***	11.5***	30.0	22.5
Haptic self-paced visual long	13.5***	11.0***	36.0	37.5	96.5**	102.0*	13.5***	12.0***	39.0	37.5
Haptic-timed > visual short	21.0*	20.0*	17.0**	19.5**	74.0***	80.0***	12.5***	15.0**	10.5***	6.0*****
Haptic-timed > visual long	17.5*	22.5	23.0	25.0	82.5***	97.5***	17.5*	17.0**	12.0***	11.5***
Haptic-timed > haptic self-paced			27.5	27.5		149.0			16.5*[b]	16.5*[b]
Haptic self-paced > haptic-timed	31.5	33.0			170.0		27.5	31.0		
Visual long > visual short		38.5	28.5	30.5	153.5	141.5	31.5	37.5	28.5	29.5
Visual short > visual long	36.0									
Movement > haptic self-paced			60.5	61.5	303.0	325.5			61.0	57.5
Haptic self-paced > movement	72.5	76.0					78.5	80.5	51.0	51.5
Haptic-timed > movement			78.0	80.5	326.0	304.5	56.0	61.5		
Movement > haptic-timed	74.0	70.0								

*p ≦ .05 **p ≦ .025 ***p ≦ .01 ****p ≦ .005 *****p ≦ .001

[a]p on the Mann-Whitney U one-tailed test

[b]This was a two-tailed test.

[c]18 Ss in each group (all Ss) were in the movement condition; 9 Ss in each group were in the other conditions.

[d]N = 36 in movement condition and 18 in other conditions.

TABLE 3

MEANS AND MEDIANS OF THE SCORES ON THE MEMORY TASKS AFTER DIFFERENT LEARNING CONDITIONS [a]

Conditions	Younger Children [b]												Older Children [c]							
	Overactive				Underactive				All Younger Ss				Overactive				Underactive			
	Immed.		Delay.		Immed.		Delay.		Immed.		Delay.		Immed.		Delay.		Immed.		Delay.	
	Mean	Median[d]																		
Movement	6.8	7.0	6.2	6.5	6.5	6.5	6.3	6.0	6.7	7.0	6.3	6.5	12.4	15.0	12.2	13.5	10.9	12.0	11.4	13.0
Haptic self-paced	7.3	7.0	6.4	5.0	5.3	5.0	5.0	5.0	6.3	6.5	5.7	5.0	12.6	15.0	12.2	15.0	8.8	9.0	9.0	9.0
Haptic-timed (7 seconds)	6.6	6.0	5.8	6.0	6.8	8.0	6.4	8.0	6.7	6.5	6.6	6.5	10.9	10.0	10.4	10.0	13.1	15.0	13.4	15.0
Visual short(7 seconds)	4.4	4.0	3.7	3.0	3.9	4.0	3.9	4.0	4.2	4.0	3.6	4.0	6.3	7.0	6.0	6.0	6.3	5.0	6.1	3.0
Visual long(14 seconds)	4.0	3.0	3.7	4.0	4.8	5.0	4.6	4.0	4.4	4.0	4.2	4.0	7.1	8.0	6.2	6.0	8.9	8.0	8.4	9.0

[a] for raw scores, refer to Appendices B & C

[b] average number correct responses out of 10 tasks

[c] average number of correct responses out of 15 tasks

[d] in each case, the Mean is given before the Median

The only significant difference between the older overactive and underactive groups was that the overactive boys performed at a higher level after the haptic and movement conditions than the underactive boys did in both the immediate and delayed tests ($p < .05$). (See Appendix D.) Another difference between the two older groups was that the older underactive boys remembered significantly more after the haptic-timed condition than after the haptic self-paced condition, while the older overactive boys did not (see Table 2). A contrast analysis of variance showed that the differences between the older groups shown in the haptic conditions were significant ($p < .05$).

There were no significant differences on any tests between the performance of the younger overactive and underactive subjects; therefore, the data from these groups have been combined to see the effect of an increase in n on the level of significance of the differences between the tests within the combined groups (see Tables 2 and 3).

There were no significant differences between immediate and delayed memory in any group. Therefore, all comparisons were made between either immediate tasks or delayed tasks. Also, no significant differences were found in any group between their performance after the long and short visual conditions.

Comparison of Immediate and Delayed Memory After the Different Learning Conditions

Younger Overactive Subjects

Movement condition vs. visual conditions.--From Table 2, one can see that the younger overactive children showed significantly better immediate memory for the pairs of toys after the movement condition (visual + haptic + movement, self-paced) than they did after the (7 second) visual short and the (14 second) visual long conditions ($p < .01$). The same results were obtained in the memory tests after the 15 minute delay ($p < .01$).

Haptic self-paced condition vs. visual conditions.--The younger overactive subjects also showed significantly better immediate and delayed memory after the haptic self-paced condition than they did after both the visual short and visual long conditions ($p < .01$).

Haptic-timed condition vs. visual conditions.--Their immediate memory was better after the haptic timed condition (7 seconds) than after both the visual short (7 seconds) and visual long (14 seconds) conditions ($p < .05$). They also remembered more in the delayed memory tests after the haptic-timed condition than they did after the visual short condition ($p < .05$) but not after the visual long condition.

Younger Underactive Subjects

Movement condition vs. visual conditions.--Like the younger overactive boys, the younger underactive subjects also remembered significantly more pairs of toys after the movement condition than they did after the visual short condition in both the immediate memory ($p < .01$) and delayed memory ($p < .05$) tests. The memory differences between the movement condition and the visual long condition were in the same direction but were not significant.

Haptic-timed condition vs. visual conditions.--After the haptic-timed condition (7 seconds), the younger underactive children remembered significantly more pairs of objects than they did after the (7 second) visual short condition in both immediate ($p < .025$) and delayed ($p < .05$) tests.

Haptic-timed condition vs. haptic self-paced condition.--The younger underactive boys remembered more pairs of objects after the haptic-timed condition than after the haptic self-paced condition in both immediate and delayed tests. These differences approached significance for these subjects.

Haptic self-paced condition vs. visual conditions.--There were no significant differences in immediate or delayed memory between these tests in the younger underactive group.

All Younger Subjects

The younger children as a whole performed better after the movement and haptic conditions than they did after the visual conditions.

Movement condition vs. visual conditions.--Their immediate memory for the paired objects was better after the movement condition than after both the visual short and visual long conditions ($p < .001$). Their delayed memory was also better after the movement condition than after the visual short ($p < .001$) and visual long ($p < .005$) conditions.

Haptic self-paced vs. visual conditions.--Their immediate memory was better after the haptic self-paced condition than after the visual short ($p < .01$) and visual long ($p < .025$) conditions. Their delayed memory was better after this haptic condition when compared to the tests after the visual short ($p < .01$) and visual long ($p < .05$) conditions.

Haptic-timed vs. visual conditions.--All of the tests after the haptic-timed condition showed evidence of more memory than in the visual conditions ($p < .01$ in all comparisons).

Older Overactive Subjects

Movement condition vs. visual conditions.--Like the younger subjects, the older overactive boys also showed significantly better immediate memory for the pairs of toys after the movement condition than they did after the visual short and long conditions ($p<.01$). The differences between their delayed memory for the object pairs after the movement condition compared to both long and short visual conditions was highly significant ($p<.001$).

Haptic self-paced condition vs. visual conditions.--The older overactive boys had significantly better immediate and delayed memory for the pairs of objects after the haptic self-paced condition than they did after both the visual short and visual long conditions ($p<.01$).

Haptic-timed condition vs. visual conditions.--The older overactive boys remembered significantly more pairs in the immediate memory tests after the (seven second) haptic-timed condition than they did after the (seven second) visual short condition ($p<.01$) and after the (14 second) visual long condition ($p<.05$). Their delayed memory was also better after the haptic-timed condition than after both the visual short and visual long conditions ($p<.025$).

Older Underactive Subjects

Movement condition vs. visual conditions.--The older underactive boys' immediate memory for the object pairs was significantly better after the movement condition than it was after the visual short condition ($p<.025$) and was better after the movement condition than after the visual long condition, but this difference was not significant. In the delayed memory tests, they remembered more after the movement condition than after both the visual short ($p < .01$) and visual long ($p < .05$) conditions.

Haptic self-paced condition vs. visual conditions.--These differences were nonsignificant in this group.

Haptic-timed condition vs. visual conditions.--In the immediate memory tests, the older underactive boys remembered significantly more pairs of toys after the haptic-timed condition than they did after both the visual short and visual long conditions ($p < .01$). In the delayed memory tests, these subjects performed significantly better after the (seven second) haptic-timed condition than they did after the (seven second) visual short condition ($p < .001$) and the (14 second) visual long condition ($p < .01$).

Haptic-timed vs. haptic self-paced condition.--The older underactive boys were the only group to remember significantly more after the haptic-timed condition than after the haptic self-paced condition in both immediate and delayed tests ($p < .025$). (These differences approached significance for the younger underactive subjects.)

Younger Groups Compared

There were no significant differences in immediate or delayed memory between the younger overactive and younger underactive groups of subjects. There was, however, an interesting pattern that can be observed in Table 4. The overactive boys remembered more in both the immediate and delayed tests after the haptic self-paced condition and in the immediate tests after the movement and visual short conditions.

The younger underactive boys remembered more after the haptic-timed and visual long conditions and in the delayed tests after the movement and visual short conditions. Because of the limited sample size of the study, one may assume that differences approaching significance with only nine subjects per condition might well be significant given a larger sample.

Table 4. Comparison of Memory after Different Learning Conditions in Overactive and Underactive Groups[a]

Memory after Conditions	Younger Subjects		Older Subjects	
	Over-actives Higher	Under-actives Higher	Over-actives Higher	Under-actives Higher
Movement (immediate)[b]	150.0		106.0*	
Movement (delayed)		160.0	138.5	
Haptic self-paced (immediate)	24.0		19.0*	
Haptic self-paced (delayed)	29.0		25.0	
Haptic timed (immediate)		40.0		22.5
Haptic timed (delayed)		33.5		22.5
Visual long (immediate)		31.5		29.0
Visual long (delayed)		29.0		23.0
Visual short (immediate)	37.0		35.0	
Visual short (delayed)		33.5	35.5	

[a]on the Mann Whitney U one-tailed test

*$p \leq .05$

[b]N=18 Ss in movement conditions and 9 Ss in the other conditions

Older Groups Compared

The memory pattern of the older subjects was very similar to that of the younger subjects. The older overactive subjects remembered significantly more pairs of toys than the older underactives did after the movement and haptic self-paced conditions in the immediate tests ($p<.05$). The overactive boys also remembered more in delayed memory tests after these two conditions with differences approaching significance. In addition, they remembered more after the visual short (7 second) condition than the older underactives did.

The older underactive boys remembered more pairs than the older overactives after the haptic-timed condition (with the U value very close to significance), and they also remembered more in the visual long (14 second) condition.

Overactive and Underactive Groups Compared

The comparisons of memory scores after the haptic conditions and the visual conditions of both younger and older groups show that the overactive subjects seemed to benefit most from movement and haptic-exploration when it was self-paced; while the underactive subjects benefited more from haptic exploration when it was limited in time (7 seconds) and from visual exploration when given additional time (14 seconds instead of 7 seconds).

In three out of four comparisons of the short visual condition, the overactive subjects showed better memory than the underactive subjects did (see Table 4). It was noted in the pilot study that the younger subjects attended only briefly to the test toys in the visual conditions and were then easily distracted. Therefore, it was assumed that these subjects might remember more in the visual short (7 second) condition. The length of the visual long condition (14 seconds) was selected to approximate the average time spent on the self-paced haptic and movement conditions in the pilot study. Although it was not predicted, it does follow that the underactive subjects would remember more after the visual long condition, because they apparently could use the additional learning time effectively while the overactive subjects seemed to lose interest or concentration after a few seconds.

Comparison of Time Spent on Task and Task Success

One of the questions of this study was to look at attention span as revealed in the self-paced conditions and find any relationship between time on task and success on task (see Appendix D). A comparison was made of the time spent in the movement condition by the overactive and underactive subjects and groups. The younger overactives spent significantly more time with the pairs of toys in the movement condition than the younger underactives did ($p<.05$). The mean time spent by the younger overactives was 25.41 seconds compared to 17.39 seconds spent by the younger underactives. There were no differences between groups in the haptic self-paced conditions. (Means were 25.1 seconds for the overactives and 23.8 seconds for the underactives.)

The older subjects spent less time in the self-paced conditions than did the younger subjects (see Appendix E). The older overactives spent more time with the toys in the haptic self-paced condition than the underactives did. (The means were 16.7 and 13.9 seconds, respectively, a difference which approached significance.) There was not a significant difference between time spent by the older groups in the movement condition. (Means were 14.8 seconds for the overactives and 14.3 seconds for the underactives.)

To analyze success on task compared to time on task, three different procedures were followed. In one procedure, 16 individual subjects, (four from each subgroup), with variable success on the test items were compared. The only pattern evident in this comparison was that there appears to be an optimal intermediate time range for successful performance based on individual self-pacing (see Appendix F).

A second method of looking at the relationship between time spent and item success was done by comparing the results of delayed tests after the visual long condition and after the self-paced items which took 14 seconds or less. The overall result was that when time is equal, all subjects benefited to some degree from haptic exploration. The younger overactives had a 36% efficiency rate with visual input only and a 54% success rate when the condition allowed manipulation. With the younger underactives, the success rates for visual alone and manipulation were 45.5% and 63.5%. The younger overactives preferred to take longer than 14 seconds as revealed in Appendix D. For the older overactives, the comparison between visual input alone versus manipulation revealed differences of 40% success for visual exploration and 84% success with manipulation (if one highly discrepant score is eliminated). The least effect of manipulation was seen in the older underactive group where the differences were 56% success with visual only and 71% with manipulation. (For details on this procedure, refer to Appendix G.)

The last procedure used to compare time spent on individual items to success on task was to plot the average time each child spend on task in relation to the number of correct responses he made. These data were plotted for each group of subjects in order to find any patterns within the group (see Appendices H and I.) The most prominent cluster was found in the older overactive subjects who showed a pattern of success related to a time range spent with the toy pairs of 10 to 20 seconds. In the other three groups of subjects there was a wide disparity in time spent as related to success.

Overall, these data are too limited to draw any firm conclusions as to an optimal time for exposing all children to a simple memory task, but there at least seems to be a good indication that for individuals there may be not only a preferred modality but also a preferred time of stimulus exposure for effective learning to occur.

CHAPTER V

DISCUSSION

The Results of this Study

This study considered the relationship between attention, memory, and bodily movement in 4- and 5-year-old and 8- and 9-year-old boys rated by their teachers as overactive or underactive. The study investigated the possibility that young school-aged boys labeled as overactive might benefit from learning experiences which involve movement, haptic exploration, and self-pacing. The purpose of the study was to investigate some of the factors which might improve learning in highly active boys. The hypotheses of the study were that:

1. The younger boys in both groups would perform best in the movement condition.
2. The older overactive boys would perform best in the movement condition.
3. The older underactive boys would perform as well in the visual condition as in the movement condition.
4. Younger and older overactive boys would perform better in the haptic tasks than in visual tasks.
5. All subjects would perform better in the self-paced haptic than in the timed haptic task.

The results can be interpreted in relationship to these hypotheses.

The first hypothesis was supported by this study. The younger subjects performed best after the movement condition. Although the older overactive subjects performed best in the movement condition as predicted in the second hypothesis, they did almost as well in the haptic self-paced condition. For these older overactive boys, it appears that the haptic exploration and the self-pacing were the most critical elements, not the movement (as had been predicted).

The third hypothesis that the older underactive boys would perform equally well in the movement and visual conditions was not supported. The assumption had been made that these subjects might display more mature behavior in regard to learning modalities. They did perform almost as well on the visual tasks as on the haptic self-paced tasks. There is a need to add another group of boys age 11 and 12 to find the group for which movement and manipulation are not more significant factors in learning than visual exposure alone. In this study the older underactives performed best in the haptic-timed condition. This result is interpreted to mean that the haptic exploration was helpful to this group, but that the self-pacing that improved performance in the overactive boys was not necessary or even helpful to the underactive boys.

As predicted in Hypothesis 4, the younger children and the older overactive ones performed better in the haptic conditions than in the visual conditions. This result for younger subjects was predicted because of the consistent pattern found by Wolff, Levin, and Longobardi (1972, 1974). In addition, the older overactives were expected to perform well after the haptic conditions as found by Tarver, Hallahan, Kauffman, and Ball (1976).

The only interaction between groups of subjects was found in relation to Hypothesis 5. The overactive subjects did perform better after the self-paced haptic condition than after the timed haptic condition. However, for underactive subjects, the results were reversed. The underactive subjects performed better in the haptic-timed task than in the haptic self-paced task. The differences between the two groups were more pronounced for the older subjects (p .05). These results give renewed importance to considering the individual differences between children. These differences appear to increase as children mature.

It was not predicted that the older underactive boys would do best after the haptic-timed condition. There are several possible explanations for this outcome. One suggestion is that these boys were motivated by the timed element of the condition as in a speed test or contest and that they might have been aroused in a competitive way. The brief time alone cannot explain the difference since the underactive group took less time than the overactive group when given the self-paced conditions but were less successful than the overactive group.

The absence of self-pacing appears to be the most significant variable. It is possible that these boys are less self-motivated and more adult or teacher directed. They were the ones identified by their teachers as able to adapt to teacher instruction (Appendix U). They might be described as more goal directed, more task oriented, or more inhibited than their overactive classmates. According to the rating scales, they are more persistent or attentive in typical classroom tasks. While the overactive boys needed the element of self-pacing, the underactive boys appeared to benefit more from external control. Different situations bring out the best in different children.

Overall, the results showed greater differences in effectiveness of learning modalities between the older groups of subjects. Also, the older overactive subjects showed a pattern of performance very similar to the performance of the younger subjects combined. This result supports the theory that the older overactive subjects are operating at a less mature level than their underactive peers. Because the high activity of these children tends to diminish at the onset of puberty, some theorists have speculated that hyperactivity might be considered a "developmental disorder" (Rosenthal and Allen, 1978, p. 698). Support for this theory comes from EEG studies that show older hyperactives with EEG patterns more representative of younger subjects. All hyperactives do not improve at adolescence and all do not show the immature EEG. These inconsistent findings give support to the idea that there are distinct subgroups within the broader category of hyperactivity.

A Model of Hyperactivity

This writer would like to suggest that there are more than the two or possibly three subgroups of hyperkinesis that have been suggested by some researchers (Satterfield, 1972; Zentall and Zentall, 1975, 1976; Farley, 1974, 1977; Loney, 1980; Rutter, 1982). It is possible to categorize hyperactive children into five subgroups, considering sustained attention to be the primary deficit and arousal to be the area showing extreme differences. The confusion that is apparent in identification of these subjects could be partially eliminated by consideration of these five subgroups.

<u>The first group</u> of children that might at some point be regarded as hyperactive is a group that receives little attention because their behavior tends to be appropriate. This group is very active on the activity continuum, but on the arousal continuum they are well modulated, and their activity is usually well inhibited. These children might occasionally disrupt a class, but most of these children probably spend their excess energy in organized or competitive athletics. It is important to note that <u>some teachers</u> might be confused by the <u>excess energy</u> of these children and consider them to be clinically hyperactive.

<u>The second group</u> of potentially identified hyperactives is a large group of children with normal levels of arousal who are temporarily and situationally hyperactive due to emotional upset or an excessive amount of external stimulation, for example most young children at Halloween. These children correctly receive little clinical attention because of the brief endurance of the presenting symptoms, but their behavior might be a source of confusion for a novice observer.

There are three groups left who tend to receive all the referrals to school counselors and psychiatrists. These three groups can also be viewed on the arousal continuum. <u>Group Three</u> is probably the smallest group and is composed of children on the high arousal end of the continuum. They are very sensitive to change of any kind and to external stimuli. They are easily distracted from assigned tasks and are often seen as emotionally volatile. Amphetamines do not help these children and sometimes make their behavior worse. This is the small group of children that are described by Schachar, Rutter, and Smith to display:

> pervasive hyperactivity, a clinically distinctive behaviour disturbance, persistence of overall disorder and marked cognitive impairment (p. 388).

This cognitive impairment might be attributed to minimal brain injury or minimal brain dysfunction (Cruickshank, 1961). This small group may have a subgroup whose source of disturbance is emotional rather than cognitive. These children in Group Three are probably the same ones who fail to outgrow the problematic symptoms at puberty and often continue to exhibit socially inappropriate behavior into adulthood. According to Satterfield,

> it is the hyperkinetic children who come from families with alcoholism and mental illness who do not respond to stimulant treatment and who become antisocial adolescents and adults (1972, p. 10).

Longitudinal studies are needed to trace these pervasively hyperactive children through their school experiences and into their adult lives.

Group Four may be the group that teachers find the most confusing. Sometimes they are hyperactive and sometimes they are not. Sometimes they are overly sensitive and sometimes they are not. These may often be described as exhibiting Jekell and Hyde behaviors. No behavioral intervention works consistently and no particular situation seems to trigger excess activity. On the arousal continuum these are the children with poor modulation. Their arousal level fluctuates and they may have little internal control over any incoming stimuli. This group offers perhaps the greatest challenge to medicine and to education. Any intervention would be constantly adjusting to the changing needs of the child. Rosenthal and Allen have suggested that stimulants might increase the lability or arousal modulation of these subjects (1978). Williamson, Lundy, and Anderson reported that no single approach to treatment was consistently effective with the children in their study (1980). It is possible that these are the children who would benefit from diet control therapy as proposed by Dr. Lendon Smith (1976, 1979). Certainly controlled studies are needed to add to the clinical observations that he has made.

Group Five is the group for which most of the current progress can be claimed. It is probably the largest of the clinically identifiable groups and contains children who are underaroused on the arousal continuum. They continually seek out increased external stimulation if their environment is limited. Clever educators have always known what to do with these children--let them clean erasers, sharpen pencils, pass out papers, etc. Intervention, whether medical or behavioral, is simple. Amphetamines raise their level of arousal and increase their inhibitory responses. Exciting environments hold their attention and allow them to use their energy appropriately. These are the children for whom Farley's formula works (1974). Koester and Farley have suggested educational alternatives to medical treatment (1977, 1981). These methods will be discussed in the Implications for Education section of this chapter.

Limitations of this Study

Three major limitations have been identified in this study. One of the limitations is in the area of identification of subjects. To begin with, it was easier for teachers to identify the older overactive subjects since their behavior tended to be more discrepant from the norm; with younger subjects in classes that allow more movement and variety, identification was more difficult. Another problem with identification has to do with controlling for intelligence differences. Some of the differences between the groups might be explained by intelligence differences. An attempt to limit subjects to those with average and above intelligence would have strengthened the data. Even though all of the subjects came from typical classrooms in public school settings, the current practice of mainstreaming handicapped children has made subject identification more complicated.

A second limitation is that of population. Because the occurrence of hyperactivity is relatively rare, a larger population base for drawing the samples would have been preferred. Rutter would argue that the overactive subjects in this study are not true hyperactives. While it is true that the subjects in this study do not represent that very small group of pervasively hyperactive subjects, it is also true that their classroom behavior was different enough from the norm that their teachers saw them as overactive. Rutter's bias is based on the lack of a "homogenous recognizable clinical syndrome" (1982, p. 31). Rosenthal and Allen acknowledge that group analysis may sometimes obscure subgroup differences but conclude that it is possible that these subgroups of "children have a similar dysfunction or set of dysfunctions" (1978, p. 706). Clearly, there is no way to separate characteristics within and between children to the degree desired by Rutter. Justification for selecting the population for this study is that inferences from the study will be applied to the classroom setting; it is reasonable then to have subjects identified by an operational definition that draws on classroom behavior.

The third limitation of the study is that the length of the task was possibly too brief. It is assumed that differences between groups might have been even greater because a number of children were able to pair all of the toys under certain conditions. Younger subjects might have shown greater differences given 12 or 14 pairs of objects, and the older subjects might have shown even greater differences with 18 or 20 pairs of objects.

Implications for Education

Young children (ages 4 and 5) usually work in school settings that allow for a reasonable amount of movement and haptic exploration. Older children (ages 8 and 9) too often are expected to behave in a fairly homogeneous manner with little or no allowance for either haptic exploration or self-pacing. The implications for education are directed to the parents, teachers, counselors, and administrators who are responsible for the education of young school-aged boys. Some boys need to move around more than others, and most boys will learn better if presentations are in a haptic modality and not limited to the traditional visual or auditory modalities only. Since the results for the older overactive subjects looked more like the results for the younger subjects than like the results for their underactive peers, teachers of these children should provide lessons for older active boys which include the opportunities for movement, haptic exploration, and self-pacing.

Sustained Attention

It is very interesting to note that the overactive subjects in this study were those described as having short attention spans. In this study, however, the overactive subjects spent more time with the individual pairs of items than did their underactive peers. One possible contributing factor to this outcome is the consideration that the movement condition allows for tension reduction. Also, these subjects were getting additional stimulus change and variety in the movement condition provided by the additional points of view available to them. This result supports Farley's theory that some hyperactive children are underaroused and stimulus-seeking (1974).

The most severe problem exhibited by hyperactive subjects in classrooms is their inability to sustain attention (Douglas, 1972). This study provided opportunities for greater selective attention by limiting the focus to two items at a time, and it provided opportunities for greater sustained attention by presenting interesting materials in a haptic modality and allowing the child to control the pace of presentation.

Cortical Immaturity

Since the results for older overactive subjects looked more like the results for younger subjects combined than the results for their underactive peers, this study gives some support to the theory that overactive subjects are cortically immature (Rosenthal and Allen, 1978). At least on a functional level if not on a neurological level, these overactive boys acted less mature. This result does imply that teachers should provide more lessons which include opportunities for movement and haptic exploration. Good teachers have always made provisions for these children, basing their decisions on their experience with children. This study gives empirical support for these classroom alternatives. It is ironic to note that, while schools make more provision for variety in classrooms of younger children, in the present study it was the older group of boys who showed more pronounced group differences indicating a need for more variety of classroom presentation modalities and more opportunity for self-pacing.

Self-pacing

Self-pacing has been demonstrated to be beneficial for normal subjects (Flavell, et al, 1970) and for hyperactive subjects as well (Sykes, et al, 1973). In this study, the haptic self-paced condition and the movement condition allowed for child-control of the pace rather than adult-control. The overactive subjects benefited from this opportunity to pace the presentation of the items. Classrooms for young boys should provide more opportunities for them to set the pace within group lessons and during independent assignments.

Self-concept

Children see themselves as the adults around them see them. A child's self-concept can be enhanced or diminished by his teacher and by his classroom environment. One of the factors found to discriminate between hyperactives and their normal peers is the low self-esteem of the former. Homatidis and Konstantareas found three factors to be significant discriminators between hyperactive and normal children: attention, aggression, and self-concept (1981). The last two are probably related. If a child is able to experience success in the classroom and win the approval of the adults in his life, it is more likely that he will be able to channel his frustration into more socially appropriate alternatives than hostile aggression.

Individual Differences

The most important single application of this study is to serve as a reminder of the importance of individual differences in learning styles. The older boys in this study did not all behave in the same way. Individuals tended to exhibit preferred modalities and preferred paces for learning. Two subjects were of special interest in the older underactive group. Their performance was unusually high after the visual condition (correctly pairing 14 and 15 sets, respectively). These two children were asked how they were able to do so well, and one replied that he had made each pair of toys do something "in my mind." When the teacher was questioned about the use of imagery used by these two boys, she replied that they were both very creative and had good imaginations. These were the only two children out of 72 for whom visual was the preferred or most successful modality, although most of the older underactive boys did better visually than their overactive peers did. In addition, these underactive subjects did not require self-pacing to learn well. This result does not necessarily mean that these less active subjects are not self-motivated. It only implies that for them to learn this simple memory task, they do not need the self-pacing. Teachers must be aware of these individual differences in order to provide effective classroom alternatives.

Although lip service has always been paid to providing lessons with a variety of modalities, many teachers still tend to rely on visual and auditory modes or a combination of these. Another important consideration for teachers of young children is the transition from one type of presentation to another. One study shows that children with attentional problems often have a special difficulty in shifting attention between auditory and visual modalities (Torgesen, 1975).

Classroom Alternatives

Recommendations for classroom alternatives based on this study are:

1. Provide classrooms which are philosophically, not necessarily architectually, open. Environments that are overly restrictive or limited in stimulation appear to complicate the behavior of overactive (low arousal) children (Koester and Farley, 1981). There is also evidence that these children are more successful in open versus traditional settings. Koester and Farley found that "children in open classrooms took longer to complete tasks, but also made fewer errors" (1977, p. 10).
2. Provide variety in the teacher presentation and student use of materials. Encourage experimentation and exploration.

Koester and Farley recommend classrooms for low arousal hyperactive children that "provide varied stimulation, flexibility of time schedules, and many alternatives--choices and decisions made by the child" (1981, p. 94).

3. Be aware that much disruptive behavior is a result of boredom. Provide opportunities for children to help determine the curriculum. High interest, age appropriate choices (preset by the teacher) give children the chance to choose topics or materials which interest them and will therefore contribute to lengthened attention span.

4. Allow, when possible, opportunities for children to select their preferred modality. Do not present every lesson in the same one or two modalities. The boys in this study learned best when they were able to manipulate the paired items using the haptic modality. Teachers should extend the use of concrete objects, often used in math classes, to other areas of the curriculum.

5. Young children in general are more distractible than older children are (Humphrey, 1982). This implies that some immature overactive or underactive children may be easily distracted by excessive amounts of visual and/or auditory stimulation. This writer would suggest that, just as there are also individually determined "easily overloaded" modalities. Considering this possibility teachers might try to avoid overloading any perceptual system, visual, auditory, or haptic. Teachers can also prepare lessons and materials

which allow easy focus, eliminating excessive extraneous figures and diminishing figure/ground confusion.

6. Allow when possible opportunities for children to pace themselves. Koester and Faley have speculated that "allowing children to pursue tasks at their own pace without emphasizing group competition might be facilitative of a more reflective style" (1977, p. 10). This recommendation echos the findings of Flavell, et al, (1970) and Sykes, et al, (1973). In classrooms today, many children are penalized because the quantity of their work in the teacher's time table is not sufficient. Many of these same children would work more successfully if given the freedom to pace themselves.

7. Allow, when possible, opportunities for young children (boys under age 10, as indicated by this study) to move around as they are learning. Providing the opportunity for "change in motion" and "physical expenditure of energy" is recommended by Koester and Farley (1981, p. 95). Movement supplies two additional benefits: it can reduce tension and it can increase stimulation by increasing the visual points-of-view.

8. The last recommendation is for teachers to remember that their perceptions of children have a pronounced effect on their behavior in the classroom. Since hyperactive children have been found to have low self-esteem (Homatidis and Konstantareas, 1981 and Loney, 1980), it is important with

these children to provide tasks that can be completed in a reasonable length of time and that will in themselves provide immediate gratification. Consistent reinforcement is recommended for these children also (Koester and Farley, 1981).

Conclusions

In general, these recommendations apply to most school-aged children, not just boys and not just those identified as overactive. The single most important emphasis of this paper is to show that individual children have individual learning needs that must be met by the classroom environment and by the teacher. A few children probably do need restricted stimulation, but most of the children disrupting classrooms at any one moment in time are those who are understimulated, bored, and restless. Providing exciting lessons and interesting learning centers, while allowing some movement within and between classes, could eliminate a substantial portion of the disruptive behavior and at the same time provide a more constructive learning environment.

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Appendix A

Rating Scale

Instructions to parent or teacher: Circle the number corresponding to the best descriptor of the child in each category.

Child's name____________________ Rater's name__________________

Age of child_____________ Date of Birth________________

Frequency/Type of Activity

1 Almost always moving; displaying high energy

2 Usually moving

For younger children: engages in active play such as climbing, running, sliding, etc.

For older children: frequently exhibiting extraneous movement, such as moving feet, tapping pencil, shifting position in seat, getting out of desk, etc.

3 Active when active play is most appropriate, such as playground, jungle gym, during games, etc.; but plays or works quietly at other activites such as painting, bead stringing, etc.

4 Usually engaged in quiet activity

For younger children: usually chooses books, puzzles, etc. over vigorous activity described in #2 above

5 Extremely inactive, sedentary

Temper/Ability to Wait

1 Impetuous, can't wait, may have temper tantrums or other disruptive behaviors such as pushing or yelling

2 Occasionally patient but usually will move on to another activity rather than wait, or will show irritability or excitability

3 Can take turns or wait successfully under most circumstances, such as standing in line

4 Usually calm and only shows impatience after a long wait

5 Child is extremely patient, calm and relaxed

Planning/Task Involvement

1 Never plans, dives into things carelessly and often leaves activities incomplete

2 Seldom plans and usually flits from one activity to another

3 May or may not demonstrate planning overtly but does stay involved with the task as it evolves

4 Usually plans but sometimes acts on the spur of the moment

5 Plans purposefully and acts on his plans

Tenacity/Attention

1 Shows no persistent interest; may be prone to daydreams

2 Occasionally tenacious when task is extremely novel or engaging

3 Easy to attract child's interest and hold for a reasonable period such as the length of a story

4 Usually tenacious but may show shorter attention span when upset or if activity is too easy or hard

5 Unusually persistent despite difficulty of task or presence of distraction

Sensitivity to Change

1 Very sensitive to any change in routine or environment
For younger children: needs help during transition times
For older children: may demand explanations from teacher

2 Frequently sensitive to small changes in routine or environment

3 Adaptable and flexible in most situations, only shows sensitivity to more pronounced changes such as new teacher, fire drill, etc.

4 Usually adaptable and flexible

5 Extremely adaptable; almost never upset by small changes

Total Score on rating scale:________

APPENDIX B

RAW SCORES FOR YOUNGER SUBJECTS [a]

	Movement				Haptic S-P[c]				Haptic Timed				Visual Long				Visual Short			
	O		U		O		U		O		U		O		U		O		U[b]	
	i	d	i	d	i	d	i	d	i	d	i	d	i	d	i	d	i	d	i	d[d]
1.	10	10	10	10	10	10	10	10	10	10	10	10	8	8	8	8	9	8	5	6
2.	10	9	10	10	10	10	7	7	10	8	9	9	7	5	7	6	6	6	5	5
3.	10	9	10	10	10	8	7	7	9	7	9	8	5	4	6	6	6	4	5	5
4.	9	9	9	10	8	6	7	6	7	7	8	8	4	4	6	6	5	4	5	4
5.	9	8	9	9	7	5	5	5	6	6	8	8	3	4	5	4	4	3	4	4
6.	8	8	8	9	6	5	5	4	5	4	6	6	3	3	4	4	3	3	4	4
7.	8	7	8	8	6	5	3	3	5	4	4	4	3	3	4	4	3	2	3	3
8.	8	7	8	8	6	5	3	2	4	3	4	3	2	1	2	3	2	2	3	2
9.	7	7	7	7	3	4	1	1	3	3	3	2	1	1	1	0	2	1	1	2
10.	7	6	6	5																
11.	7	5	6	5																
12.	6	5	5	4																
13.	6	5	5	4																
14.	5	4	4	3																
15.	5	4	4	3																
16.	4	4	4	3																
17.	2	3	3	3																
18.	2	2	1	2																

[a] 4- and 5-year-olds

[b] O= Overactive U= Underactive

[c] S-P= Self-paced

[d] i= immediate d= delayed

APPENDIX C

RAW SCORES FOR OLDER SUBJECTS [a]

	Movement				Haptic S-P [c]				Haptic Timed				Visual Long				Visual Short			
	O		U		O		U		O		U		O		U		O		U [b]	
	i	d	i	d	i	d	i	d	i	d	i	d	i	d	i	d	i	d	i	d [d]
1.	15	15	15	15	15	15	15	15	15	15	15	15	11	9	13	13	9	8	15	14
2.	15	15	15	15	15	15	14	15	15	15	15	15	9	8	13	12	8	8	14	12
3.	15	15	15	15	15	15	13	14	14	15	15	15	9	8	12	11	8	7	8	8
4.	15	15	14	15	15	15	11	9	14	13	15	15	8	7	11	11	8	7	8	8
5.	15	15	14	15	15	15	9	9	10	10	15	15	8	6	8	9	7	6	5	3
6.	15	15	13	4	14	13	8	9	9	8	13	15	6	6	8	7	5	6	3	3
7.	15	15	13	13	14	12	4	4	8	8	11	11	5	5	7	6	5	5	3	3
8.	15	15	12	13	7	7	3	4	7	5	10	11	5	4	5	6	4	4	1	2
9.	15	14	12	13	3	3	2	2	6	5	9	9	3	3	3	1	3	3	0	2
10.	15	13	12	13																
11.	14	13	11	11																
12.	13	13	9	10																
13.	12	12	8	10																
14.	11	11	8	9																
15.	9	11	8	9																
16.	7	7	7	6																
17.	5	5	5	6																
18.	2	0	5	3																

[a] 8- and 9-year-olds

[b] O= Overactive U= Underactive

[c] S-P= Self-paced

[d] i= immediate d= delayed

APPENDIX D

AVERAGE TIME SPENT PER OBJECT PAIR
Younger Children, Self-paced Tasks

Overactives		Underactives	
Haptic Self-paced	Movement	Haptic Self-paced	Movement
25.1	25.4	23.8	17.39 [a]

[a] average time in seconds

There was no difference in the haptic self- paced condition for younger Ss. The overactives tended to spend more time per object pair in the movement condition. The difference approaches significance.[b]

[b] In the movement comparison, if you eliminate the highly discrepant time of 36.1 seconds in the underactive sample, the U of 116.5 changes to a U of 89.5 which is significant at the .05 level.

APPENDIX E

AVERAGE TIME SPENT PER OBJECT PAIR
Older Children, Self-paced Tasks

Overactives		Underactives	
Haptic Self-paced	Movement	Haptic Self-paced	Movement
16.7	14.8	13.9	14.3 [a]

[a] average time in seconds

There was no difference in the time spent in the movement condition, but the overactives spent more time in the haptic self-paced condition. The result approaches significance.[b]

[b] The U for this difference was 26. A U of 21 is significant at the .05 level for a 9 x 9 comparison.

APPENDIX F

TIME SPENT COMPARED TO CORRECT RESPONSE FOR INDIVIDUAL SUBJECTS

	Younger Subjects								Older Subjects							
Percentage correct with:	overactives				underactives				overactives				underactives			
2 highest times	50	100	0	0	100	0	50	100	100	100	33	66	33	66	66	33
2 lowest times	0	0	100	50	50	66	50	0	66	0	33	33	0	33	66	33
6 mid times	83	50	66	66	33	50	50	50	23	55	55	77	77	44	55	66

There was no pattern for the self-paced conditions that indicated that for individuals, the amount of time spent on the individual items was a significant variable affecting success on the task.

APPENDIX G

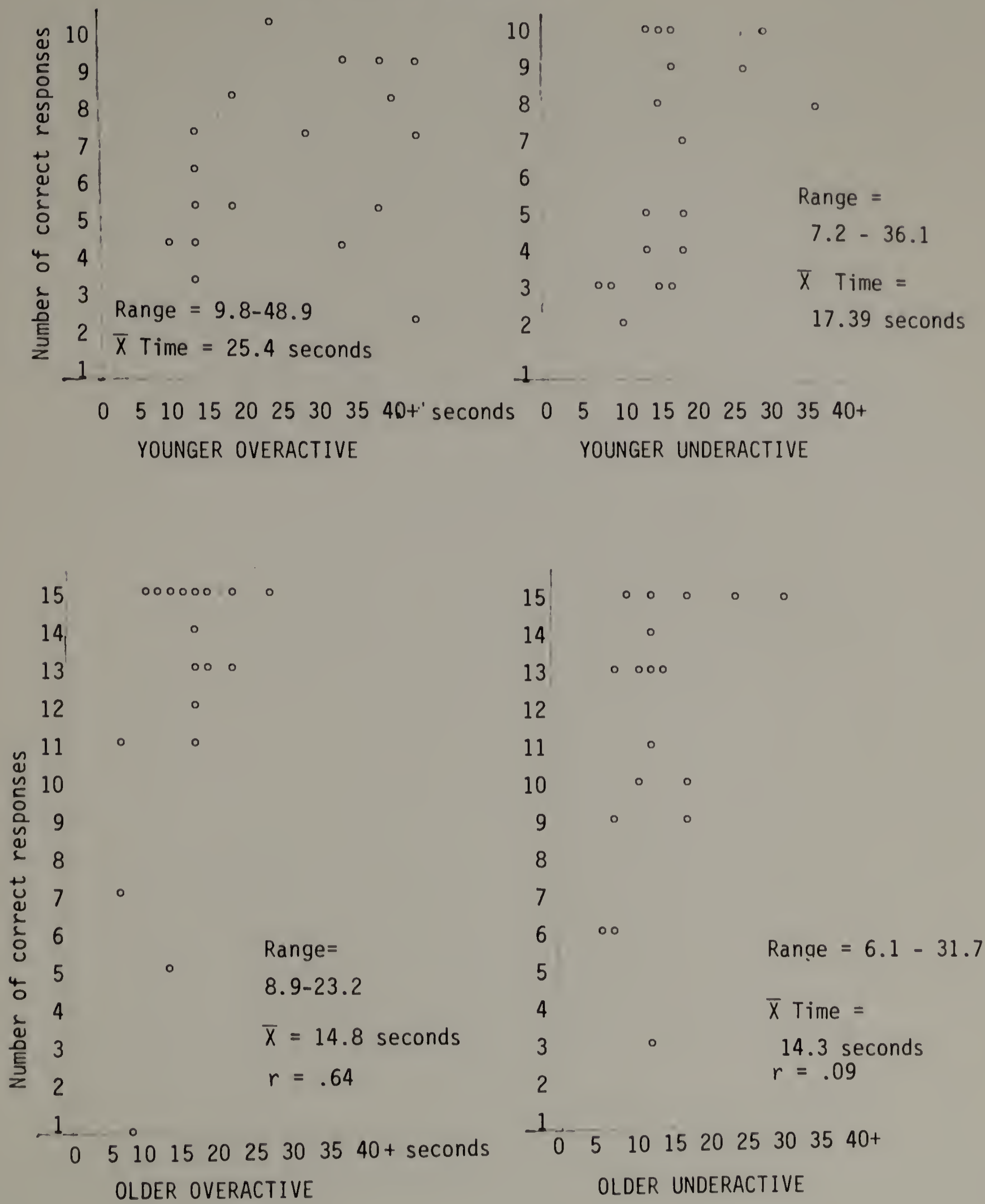
PERCENTAGE OF CORRECT DELAYED RESPONSES COMPARED TO NUMBER OF ITEMS OF FOURTEEN SECONDS OR LESS [a]

Subject #	OVERACTIVE				UNDERACTIVE			
	Younger		Older		Younger		Older	
	visual	self-p.	visual	self-p.	visual	self-p.	visual	self-paced
1	10/10%	10/70%	15/27%	19/89%	10/0%	10/20%	15/73%	29/76%
2	10/80%	7/14%	15/53%	9/100%	10/60%	5/80%	15/40%	15/33%
4	10/10%	0/0%	15/60%	14/43%	10/30%	5/40%	15/73%	12/92%
7	10/50%	5/80%	15/20%	14/ 0%	10/60%	5/100%	15/60%	13/62%
8	10/40%	6/66%	15/40%	13/77%	10/40%	5/100%	15/86%	13/85%
10	10/40%	2/50%	15/40%	12/100%	10/60%	8/75%	15/46%	21/62%
12	10/30%	2/100%	15/33%	14/86%	10/40%	11/27%	15/40%	2/100%
14	10/40%	1/0%	15/40%	4/75%	10/40%	10/30%	15/80%	8/63%
17	10/30%	0/0%	15/47%	7/100%	10/80%	1/100%	15/6%	3/67%
$\bar{X}$ %	36%	54%	40%	74%	45.5%	63.5%	56%	71%

[a] In each case, the numeral given is the number of pairs shown in the visual long condition (10, younger and 15, older), or in the case of self-paced items, the number of items that took 14 seconds or less.

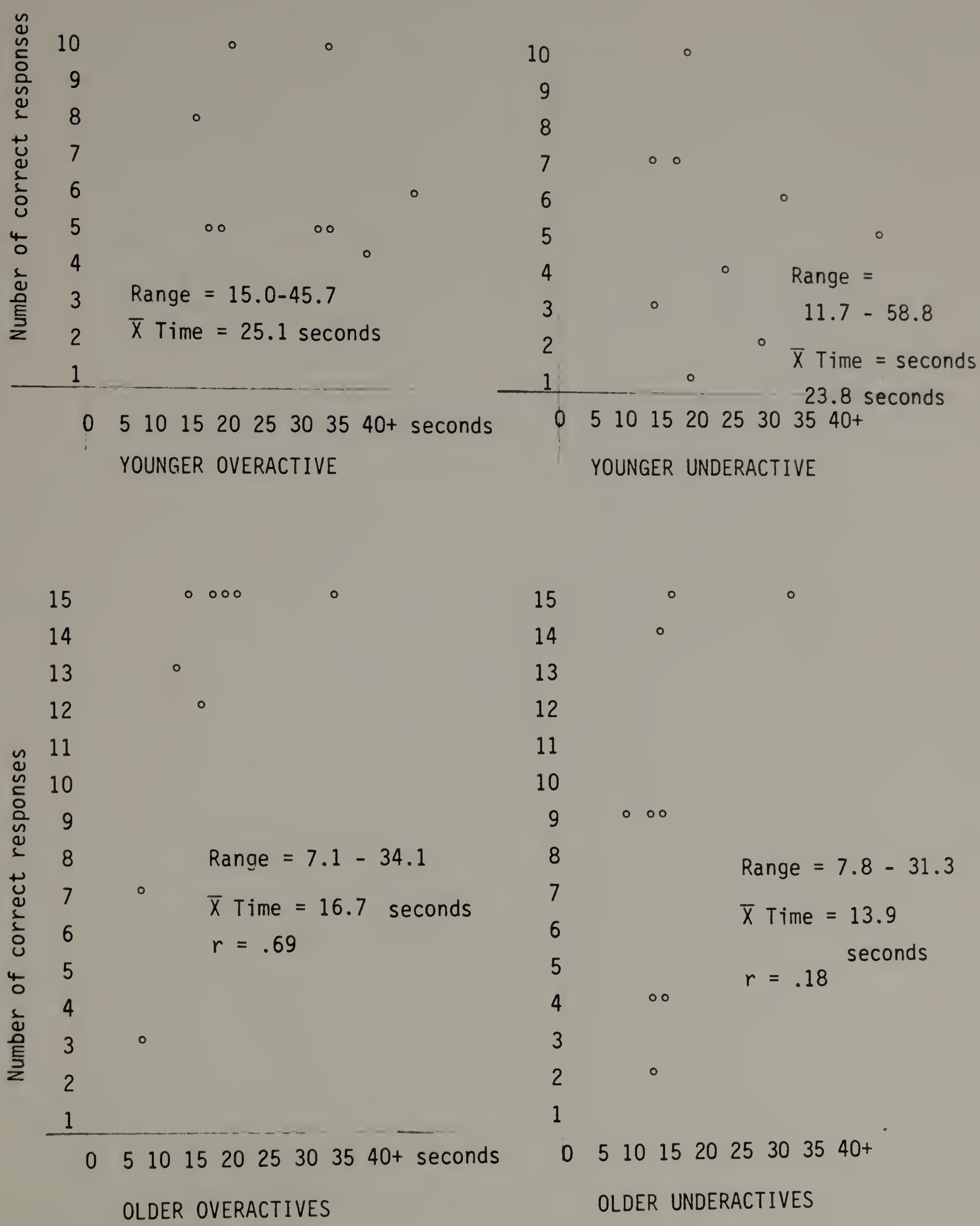
APPENDIX H

Delayed Memory After Movement Condition in Relation to Average Time Spent Per Object Pair



APPENDIX I

Delayed Memory After Haptic Self-paced Condition in Relation to Average Time Spent per Object Pair



APPENDIX J
Parent Letter

, 1982

Dear Parents,

I am a graduate student at the University of Massachusetts studying Early Childhood Education. For my dissertation project, I am studying children's learning under various conditions.

The procedure to be used consists of one child at a time playing a kind of memory game with me. The child may be asked to remember "Which toys go together?" after only looking at the combinations briefly, by playing briefly with them, or by moving around a designated area uncovering the toys and then playing with them. Each child will spend 1½ to 2 hours out of the classroom, half of the time working with me, and half the time(during 15 minute delays) working on his regular school work or other activities(puzzles, books, etc.). Each child will participate in three learning conditions.

The information gathered will be shared with your child's school. Hopefully, we will gain information about the best ways for young children to approach simple memory tasks. Your child's confidentiality will respected at all times. The information needed for the study is the child's first name and his birthdate. Your child will be selected for the study based on teacher assessment of his activity level during school hours. This information will be used to divide the participating children into comparison groups based on the level of activity most often observed. If you have any questions about the selection process or the study procedures or results, please contact me by phone at 549-4020.

The teacher and I may select your child ________________ to be included in the study. Please return the portion below to school to notify us of your willingness for your child to participate. Please return by ____________________.

Sincerely,
Pamela Snow
Pamela Snow

I give permission for my child ________________ to participate in the research study with Pamela Snow at _____ ______School_____.

____
Parent's Signature

______ No, I do not wish for my child to participate.

APPENDIX K

Score Sheet - Younger

Name______________________ Age____________ Score on Scale_____

_____List One Condition___________

		immediate	delay	time
1.	measuring cup, alligator			
2.	toothbrush, squirrel			
3.	horse, boy			
4.	scoop, farmer			
5.	airplane, turtle			
6.	rocking chair, pig			
7.	scooter, bracelet			
8.	Mickey Mouse, pear			
9.	book, monkey			
10.	house, screwdriver			
	Totals			

_____List Two Condition___________

1.	truck, seal			
2.	giraffe, orange			
3.	pliers, teenager			
4.	car, elephant			
5.	boat, cow			
6.	Indian, brush			
7.	girl, basket			
8.	shoe, padlock			
9.	bulldozer, saw			
10.	camel, rolling pin			
	Totals			

_____List Three Condition___________

1.	comb, kangaroo			
2.	bus, sock			
3.	Snoopy, belt			
4.	spoon, hat			
5.	ball, raccoon			
6.	watch, scissors			
7.	flowerpot, beetle			
8.	teapot, grape			
9.	hippo, boots			
10.	turkey, notebook			
	Totals			

APPENDIX L

Score Sheet - Older

Name________________________ Age____________ Score on Scale_____

_____List One Condition____________

		immediate	delay	time
1.	measuring cup, alligator	_____	_____	_____
2.	train, fish	_____	_____	_____
3.	toothbrush, squirrel	_____	_____	_____
4.	horse, boy	_____	_____	_____
5.	scoop, farmer	_____	_____	_____
6.	airplane, turtle	_____	_____	_____
7.	rocking chair, pig	_____	_____	_____
8.	clock, hammer	_____	_____	_____
9.	scooter, bracelet	_____	_____	_____
10.	Mikey Mouse, pear	_____	_____	_____
11.	book, monkey	_____	_____	_____
12.	marble, helicopter	_____	_____	_____
13.	elk, cradle	_____	_____	_____
14.	house, screwdriver	_____	_____	_____
15.	Oscar, cowboy	_____	_____	_____
	Totals	_____	_____	

_____List Two Condition____________

		immediate	delay	time
1.	apple, magnifier	_____	_____	_____
2.	truck, seal	_____	_____	_____
3.	giraffe, orange	_____	_____	_____
4.	pliers, teenager	_____	_____	_____
5.	car, elephant	_____	_____	_____
6.	guitar, lamp	_____	_____	_____
7.	boat, cow	_____	_____	_____
8.	donkey, banana	_____	_____	_____
9.	Indian, brush	_____	_____	_____
10.	girl, basket	_____	_____	_____
11.	panda, spoon	_____	_____	_____
12.	shoe, padlock	_____	_____	_____
13.	bulldozer, saw	_____	_____	_____
14.	camel, rolling pin	_____	_____	_____
15.	flower, cup	_____	_____	_____
	Totals	_____	_____	

_____List Three Condition____________

		immediate	delay	time
1.	dog, plate	_____	_____	_____
2.	comb, kangaroo	_____	_____	_____
3.	bus, sock	_____	_____	_____
4.	Snoopy, belt	_____	_____	_____
5.	lion, farm girl	_____	_____	_____
6.	spoon, hat	_____	_____	_____
7.	ball, raccoon	_____	_____	_____
8.	rat, mirror	_____	_____	_____
9.	cookie cutter, sheep	_____	_____	_____
10.	watch, scissors	_____	_____	_____
11.	flowerpot, beetle	_____	_____	_____
12.	scarecrow, baby	_____	_____	_____
13.	teapot, grape	_____	_____	_____
14.	hippo, boots	_____	_____	_____
15.	turkey, notebook	_____	_____	_____
	Totals	_____	_____	

APPENDIX M

Order of Presentation for 4- and 5-year-olds

	List I	List II	List III
1.	measuring cup/alligator	shoe/padlock	teapot/grape
2.	house/screwdriver	camel/rolling pin	watch/scissors
3.	scoop/farmer	boat/cow	hippo/boots
4.	airplane/turtle	Indian/brush	turkey/notebook
5.	book/monkey	truck/seal	flowerpot/beetle
6.	Mickey Mouse/pear	car/elephant	bus/sock
7.	scooter/bracelet	bulldozer/saw	Snoopy/belt
8.	horse/boy	giraffe/orange	spoon/hat
9.	rocking chair/pig	pliers/teenage girl	ball/raccoon
10.	toothbrush/squirrel	girl/basket	comb/kangaroo

APPENDIX N

Order of Presentation for 8- and 9-year olds

	List I	List II	List III
1.	measuring cup/alligator	panda/motorcycle	teapot/grape
2.	Oscar/cowboy	shoe/padlock	watch/scissors
3.	house/screwdriver	guitar/lamp	hippo/boots
4.	scoop/farmer	camel/rolling pin	lion/farmgirl
5.	marble/helicopter	boat/cow	turkey/notebook
6.	airplane/turtle	donkey/banana	flowerpot/beetle
7.	book/monkey	Indian/brush	dog/plate
8.	Mickey Mouse/pear	apple/magnifier	bus/sock
9.	scooter/bracelet	truck/seal	scarecrow/baby
10.	train/fish	car/elephant	Snoopy/belt
11.	horse/boy	bulldozer/saw	cookiecutter/sheep
12.	clock/hammer	giraffe/orange	spoon/hat
13.	elk/cradle	pliers/teenage girl	ball/raccoon
14.	rocking chair/pig	girl/basket	rat/mirror
15.	toothbrush/squirrel	flower/cup	comb/kangaroo

APPENDIX O

Lists Counterbalanced
with Conditions

	Movement	Haptic	Visual
List	1	2	3
List	2	3	1
List	3	1	2

	Movement	Visual	Haptic
List	3	2	1
List	1	3	2
List	2	1	3

	Visual	Movement	Haptic
List	1	2	3
List	2	3	1
List	3	1	2

	Visual	Haptic	Movement
List	3	2	1
List	1	3	2
List	2	1	3

	Haptic	Visual	Movement
List	1	2	3
List	2	3	1
List	3	1	2

	Haptic	Movement	Visual
List	3	2	1
List	1	3	2
List	2	1	3

APPENDIX P

Summary of Conditions by Positions
for Each Subgroup

	First	Second	Third	Totals
Movement	6	6	6	18
Visual short	3	3	3	9
Visual long	3	3	3	9
Haptic timed	3	3	3	9
Haptic self-paced	3	3	3	9

Summary of Conditions by Positions for
Entire Study

	First	Second	Third	Totals
Movement	24	24	24	72
Visual short	12	12	12	36
Visual long	12	12	12	36
Haptic timed	12	12	12	36
Haptic self-paced	12	12	12	36

APPENDIX Q

Counterbalancing of Conditions

First	Second	Third
movement(3)	haptic timed(1) self-paced (2)	visual short(1) long(2)
visual short(2) long(1)	movement(3)	haptic timed(1) self-paced(2)
haptic timed(2) self-paced(1)	visual short(2) long(1)	movement(3)
movement(3)	visual short(1) long(2)	haptic timed(2) self-paced(1)
haptic timed(1) self-paced(2)	movement(3)	visual short(2) long(1)
visual short(1) long(2)	haptic timed(2) self-paced(1)	movement(3)

The number of children in each condition for each of the four sub-groups is indicated in parentheses.

APPENDIX R

Order of Presentation
of Conditions by Subject

1.	movement	haptic self-paced	visual long
2.	visual long	movement	haptic self-paced
3.	haptic timed	visual short	movement
4.	movement	haptic timed	visual long
5.	visual short	movement	haptic self-paced
6.	haptic self-paced	visual short	movement
7.	movement	visual long	haptic timed
8.	haptic timed	movement	visual long
9.	visual short	haptic timed	movement
10.	movement	visual long	haptic self-paced
11.	haptic self-paced	movement	visual short
12.	visual long	haptic self-paced	movement
13.	visual short	movement	haptic timed
14.	haptic timed	visual long	movement
15.	movement	visual short	haptic timed
16.	haptic self-paced	movement	visual short
17.	visual long	haptic timed	movement
18.	movement	haptic self-paced	visual short

APPENDIX S

Conditions and Lists for Each Subject

1.	movement list 1	haptic self-paced 2	visual long 3
2.	visual long 1	movement 2	haptic self- 3 paced
3.	haptic timed 1	visual short 2	movement 3
4.	movement 2	haptic timed 3	visual long 1
5.	visual short 2	movement 3	haptic self- 1 paced
6.	haptic self-paced 2	visual short 3	movement 1
7.	movement 3	visual long 2	haptic timed 1
8.	haptic timed 3	movement 2	visual long 1
9.	visual short 3	haptic timed 2	movement 1
10.	movement 1	visual long 3	haptic self- 2 paced
11.	haptic self-paced 1	movement 3	visual short 2
12.	visual long 1	haptic self-paced 3	movement 2
13.	visual short 3	movement 1	haptic timed 2
14.	haptic timed 3	visual long 1	movement 2
15.	movement 2	visual short 1	haptic timed 3
16.	haptic self-paced 2	movement 1	visual short 3
17.	visual long 2	haptic timed 1	movement 3
18.	movement 3	haptic self-paced 1	visual short 2

APPENDIX T

Number of Subjects Rated and Studied per School

OLDER SUBJECTS

Name of School		Teachers Rated	Included in Study
Marks' Meadow		16	11
Federal North		.16	12
Four Corners		12	8
Pelham		5	3
Wildwood		4	2
	Totals	53	36

YOUNGER SUBJECTS

Name of School		Teachers Rated	Included in Study
Marks' Meadow		14	9
Amherst Nursery and K		14	10
Northampton Headstart		14	7
Four Corners		10	4
Hampshire County A C		6	6
	Totals	58	36

There were a total of 35 participants from Amherst-Pelham area, 24 from Greenfield, and 13 from Northampton. All of these towns are in Western Massachusetts.

APPENDIX U

RATING SCALE COMPARISONS

Older Subjects (Overactive / Underactive)

		1	2	3	4	5
Most Active – Most Inactive	Overactive	9	8	1		
	Underactive			13	5	
Most Impulsive – Most Patient	Overactive	6	10	2		
	Underactive			7	4	7
No Planning – Most Planning	Overactive	3	9	6		
	Underactive			6	5	7
No Persistence – Most Persistent	Overactive	1	13	1	3	
	Underactive			5	8	5
Most Sensitive – Most Adaptable	Overactive	7	4	5	2	
	Underactive	1		2	9	6

Younger Subjects (Overactive / Underactive)

		1	2	3	4	5
Most Active – Most Inactive	Overactive	5	13			
	Underactive		1	12	4	1
Most Impulsive – Most Patient	Overactive	6	12			
	Underactive			6	8	4
No Planning – Most Planning	Overactive	3	10	5		
	Underactive			9	4	5
No Persistence – Most Persistent	Overactive		13	4	1	
	Underactive			9	6	3
Most Sensitive – Most Adaptable	Overactive	7	7	4		
	Underactive			6	7	5

RATINGS ON SCALE: 1 2 3 4 5