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THE EFFECTS OF PAIRING OLFACTORY STIMULI WITH WORDS ON THE ACQUISITION OF WORD RECOGNITION
SKILLS OF KINDERGARTEN STUDENTS.

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CHAPTER I

THE PROBLEM

A. Introduction

The acquisition of reading skills continues to be a primary concern for all educators regardless of the student population for whom they are responsible. Many investigators have conducted research on reading problems of students categorized as learning disabled. Their investigations have focused on sensory processing deficits as the main contributory variables or causative factors, resulting in reading failure (Cawley, Goodstein, and Burrow, 1968, Erickson, 1969, Doehring and Rabinovitch, 1968, Leeds, 1971, Samuels, 1971, Schevill, 1971, Guralnick, 1972). The specific learning channels which have been studied most frequently are visual, auditory and/or haptic modes (Birch and Belmont, 1964, Hurley, 1968, Erickson, 1969, McGrady and Olson, 1970, Schevill, 1971, Deutch, 1972, Hammill, 1972, Waugh, 1973, and VandeVoort and Senf, 1973). Teaching approaches were proposed by many authors to capitalize on a student's demonstrated modality preference or to strengthen the weak modality (Johnson and Myklebust, 1967, p. 64; Meyers and Hammill, 1969, p. 133, Kirk, 1971, p. 55; and Lerner, 1971, p. 119).

An intensive review of the literature uncovered no studies which attempted to investigate the olfactory sensory mode to enhance
acquisition of reading skills. Any reference to the olfactory mode was generally an acknowledgement of its existence as one of the basic sensory channels through which human organisms receive and process information. According to Johnson and Myklebust (1967, p. 26), olfaction, gustation, and proprioception are not as closely associated with neurogenic learning disabilities and therefore are not considered important to the field, even though it is recognized that all the senses are involved in learning. The same authors further stated:

Perhaps because verbal systems are predominately auditory or visual it is these modalities about which most information and knowledge have been gained (p. 20).

Two exceptions to the assumption that olfaction is relatively unimportant to academic learning were found. In Stephens' (1970, p. 84-85) text, procedures for assessing the olfactory modality were outlined for the purpose of determining whether or not it was a viable channel for learning. Edgington (1968, p. 24) suggested using olfactory stimuli to help children form mnemonic associations for the short vowel sounds. Limited numbers of commercially available beginning reading materials have become available which utilize the olfactory modality as an additional motivational factor for young children (e.g., Rowland, 1971 and Howard, 1971). However, no known experimental data are available relating the impact of the olfactory materials to learning. Instruction which incorporates the olfactory sense as another modality for receiving and processing information should be investigated. Bilenker (1967, p. 30) postulates that all
available sensory stimuli associated with an object should be utilized to promote comprehension of new words. The use of olfactory cues in conjunction with the spoken word (auditory cue) and the written word (visual cue) may be a learning aid which has been overlooked. The process of reading requires meaningful interpretation of verbal symbols (Harris, 1961, p. 8). In order to interpret symbols the student must form critical associations between an object and its name. These associations are then attached to the graphic representation. Adding the olfactory cues to the process of learning graphic symbols for words could increase the probability of a student forming such associations more readily. If the addition of the olfactory mode does enhance learning then another alternative will be available to children with deficits of an auditory or visual processing nature.

B. Review of the Literature

In order to provide an overview of the modality issue in reading, representative articles are presented. The first section of the literature review includes research studies in which material to be learned was presented through a specified modality to compare effects on some subsequent achievement measure. Part two presents studies in which subjects' preferred modality was identified prior to treatment. The third section deals with literature specifically related to the olfactory modality.

The interest in the sensory processing modalities involved in acquiring reading skills is related to the emphasis on diagnostic prescriptive teaching. As Blanton (1971) points out, "the ultimate goal of reading instruction is to provide the student with the most effective and efficient reading instruction possible." (p. 210) De Hirsch, Jansky and Langford (1965, p. 210) suggested that teaching methods should be determined by a child's modality strengths and weaknesses. In the area of learning disabilities the shift has been away from changing the rate of teaching since rate is tied to the IQ notion and toward modifying the presentation of material to be learned (Bateman, 1968, p. 105). Unfortunately, even a cursory look at the studies which have been done makes it apparent that well defined relationships between modality and learning have eluded educators.

The specific modalities which were manipulated seemed to be determined by the investigators' assumption that reading acquisition is primarily dependent on one or a combination of perceptual processes. In a recent study Buckland and Balow (1973) compared the effects of visual perceptual instruction on reading and on perceptual gains with 156 first grade subjects rated as low in reading. The subjects in the sample who were assigned to the experimental groups were exposed to Frostig materials for development of visual perception. The remainder of the sample comprised the control group. Controls were given the same time as the experimental sample but their activities involved listening to taped stories and participating
in discussions about the stories. Comparisons of the groups' post-test scores on perceptual skills, readiness for reading and word recognition were not significant. When scores were analyzed on the basis of entry level perceptual skill, no shift in subjects ranking pre to post test was found. Contrary to expected outcomes the control subjects who ranked low on perceptual skills scored significantly higher on a posttest measure of reading readiness than the group exposed to treatment. The authors concluded that listening activities and discussion exercises were as beneficial as the visual perceptual training for low readiness children. Budhoff and Quinlan (1964) provide support for an auditory presentation on a meaningful paired associates task. They selected 56 second graders of average intelligence to study the effectiveness of visual or auditory presentation of word pairs taken from reading texts in use in the subjects' classrooms. Visual presentations involved the use of an electronically timed exposure device. The auditory presentation was recorded on magnetic tape. Stimulus response items were presented and trials to criterion were recorded. Word pairs presented auditorially were learned more quickly than those presented visually \((p < .001)\). Fewer trials to mastery were required for auditory mode pairs. Aural learning for this sample was more rapid and efficient than learning via the visual modality when the material to be learned was meaningful. Budhoff and Quinlan question whether their findings were a function of age and if the results would be reversed for older children.
Cooper and Gaeth (1967) looked into the question of age and modality preference by studying performance of 932 4th, 5th, 6th, 10th and 12th grade students. They used a 3 factor experimental design to investigate the interactions among five grade levels, two modes of presentation and the learning of verbal materials at two levels of meaningfulness. The interaction of modality by grade level was confirmed in this study. The three main effects were significant at $p < .01$. Modalities by material and modalities by grade were significant at $p < .05$. Analysis of subjects' performance showed that 4th, 5th, and 6th grade subjects performed better with nouns when presentation was visual while an auditory presentation was superior for 10th and 12th grade subjects. The more difficult consonant-vowel-consonant trigram lends itself to visual presentation across grade levels. The authors were led to suggest that at some point in language development there is no longer a functional distinction between modalities. They concluded that no inherently preferred modality for highly meaningful materials exists and that any preference for one modality over another is due to habit patterns.

Bryan (1972) postulated that learning disabled children were deficient in mediational processes when confronted with verbal material. Her study investigated the effects of forced rehearsal, voluntary rehearsal and voluntary attention on a free recall task. Words to be learned were presented visually and auditorially to learning disabled and normal subjects. Analysis of performance scores yielded significant main effects in subject type and type of
stimulus presentation. L.D. subjects' performance was poorer than normals on both modes of presentation \((p < .05)\). The visual presentation resulted in significantly higher mean scores on the recall task \((p < .01)\) for both types of subjects. Although the investigator was seeking to equalize performance on recall for L.D. subjects as a result of rehearsal of stimulus names, this was not demonstrated. The conclusion was drawn that children seem to learn a simple task (free recall) when material is presented visually and that the task is made more difficult when only auditory cues are given. A similar question formed the rationale for Otto's (1961) study; i.e., there was a tendency for visual-auditory reinforcement to result in more rapid learning than purely auditory reinforcement. He specifically wanted to learn whether there was an interaction between modality of presentation, reading ability and/or grade level. Subjects were selected from second, fourth and sixth grades. Their reading status was determined as good, average or poor for their respective grade levels. Subjects were assigned to one of three experimental conditions. Those conditions were auditory, auditory visual, and auditory visual kinesthetic. Thus, while results were presented as though only one modality was involved Otto acknowledges that the treatment conditions were cumulative. There were significant interactions between mode of presentation and grade level. Second graders required fewest trials to learn a paired associate task when the presentation stressed the kinesthetic modality. The visual mode was most efficient for fourth grade subjects while visual and kinesthetic emphasis was nearly equal for sixth grade
subjects. As would be expected, there was an inverse relationship between reading ability and number of trials required to master a list of paired associates. There was no significant interaction between mode of reinforcement and reading proficiency. This finding suggests that multi-sensory cues are not warranted for remedial teaching/learning. Generalizations of these findings to reading acquisition are not feasible since the relationship between the paired associate task and reading is not known.

Dykstra (1966) has investigated the importance of auditory discrimination to reading. A correlational analysis was conducted with 632 first grade pupils to discover intercorrelations among 7 pre-reading auditory discrimination measures, and between each measure and subsequent reading achievement at the end of grade one. Analysis of findings resulted in significant relationships between auditory discrimination tests and reading proficiency. The tests were not highly useful in predicting achievement of individual students. Dykstra warns that the relationships which were found were between measurement instruments (for auditory discrimination skills) and reading achievement. Certain of the instruments which were intended to measure the same skill failed to correlate with one another. He concluded that if a teacher's purpose is to discover who would be successful in learning to read, the intelligence test would probably be sufficient.

A study which attempted to isolate the auditory skills of normal and L.D. children was conducted by Doehring and Rabinovitch (1969). They were concerned that the contradictory findings of the modality
studies were in part a result of the failure of researchers to control the type of skills required to perform the dependent task variable. They used an oddity response task to eliminate the requirement of verbal symbolic skills. Expectations were that L.D. children would perform normally with non-verbal stimuli but would show depressed performance when verbal stimuli were used or that L.D. subjects would perform less capably on all auditory tasks. While the results were confusing (e.g., L.D. subjects were significantly better in speech reception threshold and high in speech sound discrimination but not as high as normal), L.D. subjects tended to be deficient in responses to more complex non-verbal stimuli (non-meaningful) including speech sounds. The authors concluded that there was no general deficiency of auditory abilities among the subjects participating in this study. The main contribution of the Doehring and Rabinovitch study was their suggestion that since auditory stimuli are temporally presented there is no opportunity to rehearse or review and therefore such stimuli call upon skills of auditory memory rather than simple discrimination through the auditory channel.

Schевилл (1971) studied the question of temporal ordering of stimuli presented as a succession of lights, tones or tone and light. The investigator hypothesized that the auditory tasks would be more difficult for slow maturing kindergarten subjects and educationally handicapped older subjects. Schевилл considers one of the tasks the ability to order two tones consecutively sounded, to be similar to the ability to interpret the meaning of consecutive phonemes. She
compared 5 groups of subjects which included average kindergartners, slow maturing kindergartners, normal third graders, educationally handicapped students with known auditory language problems and hyperactive E.D. children without auditory language problems. She found that slow kindergartners and the slow E.H. group showed highly unequal task performance in the auditory and visual modalities. They were considerably quicker in identifying visual stimuli over the auditory stimuli. This would appear to support the suggestion of Doehring and Rabinovitch that learning handicapped children may lack necessary auditory skills.

Another approach to the problem of reading retardation is postulated by Birch and Belmont (1964). They theorized that an impairment in auditory visual integration would occur more frequently in a group of children with reading retardation than with a group of normal age mate controls. They selected 150 Scottish school children who were retarded in reading and 508 normal readers.

Subjects were required to identify a visual dot pattern which corresponded to an auditory pattern of taps. The taps were sounded and subjects had to identify the corresponding visual pattern from a choice of three on a response sheet. Differences in the means of correct responses to the auditory-visual integration pattern were significant at the \( p < .001 \) level in favor of normal readers. In addition, for both groups of subjects those who had lower integration scores obtained lower mean scores on all four reading tests given. The conclusions drawn from the Birch and Belmont study were that a primary disturbance in the ability to integrate stimuli from the two
critical sense modalities, hearing and vision, may well increase the risk of becoming a poor reader.

A study which contradicted the Birch and Belmont findings was conducted by VandeVoort and Senf (1973). They presented a series of matching tasks involving different combinations of visual and auditory stimuli and of temporal and spatial dimensions. The sample included retarded readers who were attending a center for learning problems and a group of normal subjects who demonstrated adequate reading skills. Subjects had to respond to pairs of stimuli as same or different on four 15 item experimental tasks. The findings did not support the prediction of the Birch and Belmont study that auditory visual integration tasks would discriminate between good and retarded readers. Differences of group means on tasks not involving auditory visual integration (auditory temporal - auditory temporal or visual spatial - visual spatial) was arithmetically greater than corresponding differences on auditory temporal-visual spatial task. This suggests that other than auditory visual integration was operative. The authors speculate that within group differences might account for deficits in different skills rather than a common deficit among all retarded readers such as memory factors rather than integration skills.

A more generalized approach was used in the Oakland, Harmer and Williams (1973) study. They investigated the effects of different reading instruction which emphasized an auditory or visual or combined modality approach. A group of first grade Negro children were selected initially. One half were assigned to a control group (N=32).
Of the remaining subjects eight children were randomly assigned to each of the four experimental groups. Each group met for instruction for 45 minutes per day from October through May. Each of the groups received regular basal reading instruction in their respective classrooms. The experimental treatment involved use of a supplementary phonics reading method with auditory perception activities. Another group received a visual linguistic method plus auditory perception activities. The third experimental group received only the phonics method while the fourth received only the visual linguistics method. One research hypothesis was that a program designed to train auditory perceptual skills would also enhance the development of reading skills. Findings were that while the auditory perceptual skill activities did facilitate auditory perceptual skill development, there was no support that it had a corresponding effect on reading achievement. This was found to be non-significant on 22 measures of reading achievement. A second hypothesis was that programs which were directed at the child's strong modality would be somewhat beneficial. This hypothesis was supported to some extent but the differences did not show up until follow up testing at the beginning of second grade. It was suggested that the differences were a function of the kinds of skills required by the basal reading series in the second year of instruction.

Erickson (1969) investigated visual and haptic modalities in his study. He expected that visually and haptically oriented seventh grade students would vary on their mean level of reading achievement.
Subjects' modality strengths were derived and they were classified as visually, indeterminate or haptically oriented. When subjects' reading achievement levels were compared, those whose measured preference was haptic scored a year below visual and one half year below those categorized as indeterminate in their modality preference. Erickson suggests that while instruction can be presented through the haptic mode in the areas of art or mechanical drawing, acquisition of reading skills requires training in visual perceptual skills.

Another study attempted to improve on the assessment procedures of psychosensory functioning of L.D. children (McGrady & Olson, 1970). Two groups of 8 and 9 year old subjects were selected. There were 31 L.D. subjects and 68 normal controls. Each subject was given a battery of 13 tests designed to measure intra and inter sensory aptitudes (i.e., auditory, visual, and auditory-visual stimuli) varied on symbolic and meaning dimensions. The authors expected that L.D. children would perform more poorly than normals on auditory and visual processes. Error scores were compared by age groups. It was found that in the eight year old groups L.D. children's performance on all visual symbols was consistently poorer than their normal counterparts. The nine year old L.D. children were less capable than the control subjects on all presentations using symbols regardless of the sensory modality of presentation. Problems appeared to be greater with comprehension of language stimuli rather than perception of non-verbal stimuli. McGrady and Olson
found that the sensory modality did not discriminate between normal and L.D. subjects. They believe the findings confirm that for the L.D. population the primary disability is language problem and not a perceptual one.

Summary:

This section reviewed studies designed to determine the effects of teaching to a specific modality. No attempt was made to identify subjects' strong modality. The studies cited did not result in any pattern of findings which would assist educators in making generalized modifications in reading instruction. Significant findings in one study were seldom replicated in another similar study and were frequently reversed. Differences in population samples, variables controlled and dependent measures made direct comparisons among studies difficult. No strong argument for teaching to one specific modality could be supported on the basis of the findings reviewed here.

Part 2. Research on Aptitude Treatment Interaction

The studies presented earlier focused on the effects of modality treatment or instruction on selected student samples. In the studies which follow, the investigators attempted to overcome the contradictory results by first identifying the strong modality of the subjects participating in their respective experiments.

Lilly and Kelleher (1973) provide the following definition of Aptitude Treatment Interaction Studies (ATI) as:

......research into the relationship between
subject characteristics and performance under specified treatment conditions. (p. 5)

These authors were concerned with developing a test to measure modality strengths which would have face validity in its relationship to the reading process. The instrument developed utilized 20 words which subjects knew on sight. Subjects were identified as visual or auditory learners if they achieved a 1.5 discrepancy between their scores on visual and auditory presentations. The treatment consisted of presenting stories in either a taped or typewritten format. Memory for facts under each condition was measured. Visual subjects did better on typed material while auditory subjects scored best on taped stories. The authors suggested that the reason that so much of the research is inconclusive or contradictory is due to the lack of control of type materials and presentation. They maintained that a specific instructional material must be modified to insure the only difference was modality of presentation.

Bateman (1968) conducted a study which while it was not so rigidly controlled as the Lilly and Kelleher study involved a larger number of children. Treatment conditions were more typical of actual classroom practices. The purpose of the study was to compare the effects of teaching reading to first graders through an auditory method and through a visual method. Eight first grade classes were selected to participate in the study. Subjects in four of the groups were designated as auditory or visual learners on the basis of two subtests of the ITPA. The remaining four classes were not identified as to modality preference. One half of the modality identified
subjects were taught reading utilizing a reading series which emphasized a visual approach and the remaining half were taught through an auditory method. The same procedures were followed with the non-identified classes. At the end of first grade scores on measures of word recognition and paragraph meaning were obtained. Comparisons of group scores indicated that the auditory approach was significantly superior to the visual method and that auditory modality preferred subjects were superior in performance over the visually oriented subjects. There was no interaction between modality preference and method of instruction. These findings led Bateman to conclude that for auditory preferred subjects remediation should be to the strong modality and for visual subjects remediation should be to the weak modality. It should be noted that the sample used in the Bateman study was composed of students with a mean IQ of 125 and that reading scores at the end of first grade were 2.9 for "poor" readers and 3.9 for "good" readers. Thus the sample was not typical of an average classroom group and even less typical of a group experiencing difficulty in reading. The findings seem to lend support to the theory that reading as a skill demands good auditory processing skills (Harrington and Durrell, 1955, Wepman, 1960). Waugh (1973) administered a simple recall task to 166 second grade students in a Title I program whose modality strengths had been identified. Presentations were counterbalanced so that both aptitude groups received visual and auditory instruction. Subjects were given four instructional procedures - 2 visual and auditory recall
and 2 more complex recognition tasks. The auditory subjects did consistently better than visuals on the recall task \((p < .05)\) but there was no significant difference on the more complex reading tasks. Waugh postulates that reading may be an integrative process which requires association of visual and auditory stimuli rather than a process which can rely heavily on a preferred modality.

Sixteen comparisons made in this study failed to demonstrate that instruction could be enhanced by matching presentation to the preferred modality of the subject.

Ramp and Covington (1972) selected a population with demonstrated auditory perceptual disturbances. They hypothesized that a system of reading instruction which was visually and auditorially consistent would improve the reading skills of their subjects. They employed a structured program utilizing ITA. Following approximately 70 hours of instruction subjects' gain scores on a test of oral reading were analyzed statistically. Reading gains of the 10 subjects were significantly improved \((< .05)\).

Another study which investigated the effects of training to perceptual modality strengths focused on the visual modality (Sabatino and Streisguth, 1972). Two hypothesis were examined: 1) An experimental word form configuration training program would significantly enhance both visual perceptual skills and remedial training, and 2) such training would increase the reading achievement of visually oriented subjects over auditorially oriented subjects because of the emphasis on visual input. The investigators
selected 128 first and second grade children who were failing in reading to participate in the study. From that group children with a verbal IQ of 85 or better and who were reading one half year or more below grade expectancy were chosen. Subjects were assigned to one of two groups on the basis of their measured modality preference. They were then assigned to the experimental or control group. An experimental training program was devised which incorporated a continuum of activities from gross form discrimination to the identification of configural properties of letter and word forms. Pre and post measures selected for their proposed ability to measure visual perception, reading skills and discrimination of letter and word forms were administered. Both groups significantly exceeded their pretest mean scores. The experimental group subjects exceeded the controls three-fold in their reading comprehension and visual perceptual development. The experimental visual subjects showed greater gains than either the experimental audile group or the control group on visual perception. The differences failed to reach significance. On the basis of the findings the authors maintain that visual perceptual training should be provided to students with demonstrated visual strengths. Hammill (1972) would question that conclusion on the basis of his review of visual perceptual studies. He was unable to find any research which supported a significant relationship between visual perceptual ability and reading comprehension. In 21 of 25 intervention studies reviewed, visual perceptual training did not result in improvement in
reading comprehension for first and second grade subjects. It should be noted that the Sabatino and Streisguth study did not attempt to measure reading comprehension, only word recognition, which may be considered as a lower level task. Ringler and Smith (1973) also investigated the relationship between learning modalities and word recognition. First grade students' modality preference was identified as auditory, visual or kinesthetic. Subjects were randomly assigned to one of four experimental groups or a control group. Treatment was differentiated by modality emphasis. Each treatment group differed significantly from the control group but not from each other on the word recognition criterion measure. There were no significant differences between groups when subjects' scores were grouped by modality preference and compared. Those taught by preferred modality techniques were not superior to those taught by a non-preferred method. The authors conclude that children do have preferred modalities which can be differentiated, but their findings do not support the use of instructional methods which emphasize the strong modality. Snyder and Pope (1972) determined that among a group of 204 average six year olds, there was wide variability in performance on basic auditory and visual modality skills. They also found that variability within a single subject was as great as that found between subjects. They stated that such variability should be viewed as normal in the developmental process. Their findings provide one possible explanation for the contradictory results of the aptitude interaction studies.
Summary:

Diagnostic-prescriptive teaching methods call for determining a student's most efficient mode of learning and matching instruction to that mode (Stephens, 1970, Meyer, Vergason and Whelan, 1972). Such an approach has had considerable logical appeal to educators and thus influence on teaching methods and materials. Unfortunately, experimental research designed to test the theory, has consistently failed to support or to deny positive effects on learning. It may be that Waugh (1973) and Snyder and Pope (1972) provided the only helpful conclusions in view of the conflicting results. 1) Reading as a skill, except for the simplest tasks, depends upon more than one modality aptitude and, 2) even normal children vary greatly in their development of different modalities.

Part 3. Research on Olfactory Sensory Modality

The research reviewed thus far on sensory modalities and learning was limited to visual, auditory and haptic processes. The literature on the chemical sense of smell is devoid of research on the relationships between olfactory stimuli and academic learning.

A number of scientific works have been published which dealt with the chemistry, physiology and function of olfaction (Zotterman, 1963, Wright, 1964, and Pfaffman, 1969). Most of the experimentation concerned with the effects of odors on behavior has been conducted with animals and/or insects as subjects (Weathersbee,
Weathersbee (1969) reported on the Monell Chemical Senses Center established to conduct basic research on the allied chemical senses of taste and smell. The major purpose of the center is to determine the effects of ecological changes as perceived by animals through the senses of smell and taste. There was no indication that interest would be turned to the effects of chemical sensory experience on human academic learning. Wright (1964) mentioned that the potential of the human sense of smell was largely ignored except by primitive peoples and those whose sense of sight was impaired. Schachtel (1959) suggested that the olfactory sense is relegated to a position of lesser importance in human learning as higher order senses (sight and hearing) develop. Dependence on olfactory acuity appears to be a function of age and probably of lack of training for most highly developed cultures.

The only study uncovered in the literature which approached a scientific experiment was conducted by Galton in 1894. He attempted to associate smells with simple arithmetic problems in addition and subtraction. Since he used himself as subject the results of his experiment hardly qualify for wide generalization. His work was often quoted as an impetus to later interest in the utilization of modality preferences of students to enhance learning.

Bilenker (1967) included use of olfactory clues as a necessary component of the sensory information required to form initial associations between words and objects. Only two published works
dealing with the instructional process were found. Stephens (1970) outlined procedures for assessing students' olfactory perception and recall. The information obtained would indicate to teachers whether the olfactory channel should be utilized as another modality to enhance learning. Another writer (Edgington, 1968) suggested combining an olfactory stimulus with each of the vowel sounds to give students an additional memory clue during initial learning.

Summary:

No recent studies investigated the importance of the olfactory sense either in isolation or in conjunction with other sensory clues as an adjunct to learning academic materials.

The literature review underscores the lack of information in the area of olfactory sensory processing. It is the interest of this preliminary study to determine whether it is a useful modality to pursue in the reading process.

C. Statement of the Problem

Because the literature is lacking in the area of olfactory sensory processing and learning, the investigation will be conducted in order to determine the usefulness of this sensory channel in teaching. The focus of the investigation will be: Does an initial pairing of odors with specific words to be learned increase later word recognition among beginning readers?
D. Hypotheses

1) There will be no statistically significant difference among the means of group A who receive instruction utilizing olfactory, visual and auditory stimuli, group B who receive instruction utilizing only visual and auditory stimuli, and group C who receive no instruction on a test of word recognition.

\[ H_0^1: \bar{x}_A = \bar{x}_B = \bar{x}_C \]

2) There will be no statistically significant difference \((a=.05)\) between the mean of Experimental group A, due to the effects of instruction utilizing visual, auditory, and olfactory stimuli, and the mean of Control group C, who receive no instruction, on a test of word recognition.

\[ H_0^2: \bar{x}_A = \bar{x}_C \]

3) There will be no statistically significant difference \((a=.05)\) between the mean of Experimental group B, due to effects of instruction utilizing only visual and auditory stimuli, and the mean of Control group C, on a test of word recognition.

\[ H_0^3: \bar{x}_B = \bar{x}_C \]

4) There will be no statistically significant difference \((a=.05)\) between the mean of Experimental group A, due to the effects of instruction utilizing visual, auditory and olfactory stimuli and the mean of Experimental group B, due to the effects of instruction utilizing only visual and auditory stimuli, on a test of word recognition.

\[ H_0^4: \bar{x}_A = \bar{x}_B \]
E. Operational Definitions

In order to clarify certain terms used in the study, the following definitions were used.

1) Subjects - children enrolled in a regular kindergarten class for the first year.

2) Independent variables - 1. treatment involving instruction on specific words to be learned utilizing olfactory, visual and auditory stimuli; 2. treatment involving instruction on same words but without olfactory stimuli.

3) Dependent variable - gain scores of subjects obtained by comparing pre and post test scores on a test of word recognition.

4) Olfactory labels - microfragrance labels produced commercially by the Minnesota Mining and Manufacturing Company (3-M Co.), produced in the shape and color of the object which the fragrance represents.

5) Reading stimulus cards:
   1. Standard 3 x 5 index cards containing the scented label in the form and color of the object.
   2. Standard 3 x 5 index cards containing one word, and the scented label.
   3. Standard 3 x 5 index cards containing only a word.
   4. Standard 3 x 5 index cards containing one scented label, which represents a word to be taught. Cards were laminated to prevent exposure of the olfactory stimuli.
5. Standard 3 x 5 index cards containing one word and the scented label. Cards were laminated to prevent exposure of the olfactory stimuli.
CHAPTER II
PROCEDURES
A. Design of the Study

Research Design and Methodology

An experimental research design to test the effects of presenting olfactory stimuli in conjunction with beginning reading instruction was implemented with selected kindergarten students. A non-randomized control group pretest-posttest design was selected utilizing two experimental groups and one control group (Isaac and Michael, 1971, p. 43).

The independent measure consisted of teaching selected words to identified experimental subjects. The teaching method was varied by presenting olfactory cues in conjunction with visual and auditory cues to one experimental group (Group A) and withholding olfactory cues from the second experimental group (Group B). All other treatment conditions were identical for both experimental groups. A word recognition test was administered, pre and post, to both experimental groups and to the control subjects (Group C). Subjects' performance on the posttest constituted the dependent measure. Age variables were controlled to the extent that only subjects enrolled in kindergarten for the first time were selected. An attempt was made to equalize the number of identified girls and
boys and to reflect the racial composition of the sample population. Due to lack of research data on interaction between subjects and the main independent variable (olfactory stimuli), no attempt was made to control for other subject variables.

**Selection of Sample**

It was the purpose of this study to demonstrate the effects of incorporating olfactory stimuli in the teaching of selected sight words. In order to assure that any gains could not be attributed to prior teaching of reading, kindergarten students were selected to participate in the study. The subjects for this study were non-randomly selected from kindergarten classes in two public schools in Columbus, Ohio. Each attendance area contains a high percentage of low-income families. Boys and girls from each class were chosen from an alphabetized class roster and were given the pretest measure until a pool of 30 students had been identified. Criteria for selection included: Subjects did not read more than one of 10 words on the pretest and; they were enrolled in kindergarten for the first time.

Enrollment of one of the classes included approximately 15% non-white students. Four of those students were included in the study to reflect the racial composition of the sample. Of the students tested, 16 boys and 14 girls were identified to participate in the study. The ages of the subjects ranged from 5.0 years to 5 years 11 months, with a mean age of 5 years 5 months.
Selection for Stimulus Materials

Selection of stimulus words to be taught was restricted to 10 words for which odor impregnated labels were commercially available. The words were:

- tree
- rose
- strawberry
- peach
- orange
- grape
- chocolate
- candy
- cheese
- apple

The words selected were marketed by the 3M Company for educational application. Since this was a relatively new packaging venture for the supplier, only a limited number of their total library list was available at the time of this study. Microfragrance labels which were pictorial representations of each word and the printed word were prepared in duplicate sets. The individual stimulus items were presented on standard 3 x 5 index cards (see Appendix A).

Description and Administration of Pretest Measure

Each of the 10 words which constituted the pre and post test measure, a test of word recognition, was printed on a 3 x 5 index card. A small table and three chairs were located in a vacant room made available to the Experimenter. The pretest measure was administered individually to all subjects in the sample.

The Experimenter escorted each student from his/her classroom to the vacant room. The Experimenter instructed the student to sit in a designated chair and took the opposite seat facing the student.

1Minnesota Mining and Manufacturing Company
3M Center
St. Paul Minnesota  55101
An observer (the Principal Investigator) was present to monitor the student's responses. The observer was seated slightly behind the Experimenter and facing the student. The observer timed responses and checked whether or not the response given was an intelligible verbal encoding of the stimulus word presented. The observer was equipped with a stop watch and a check sheet for each student containing the 10 words. The time of response and + or - for response accuracy was placed beside each word on the student's score sheet, (see Appendix B). The Experimenter differentiated between correct and incorrect responses by placing cards on the table in opposing directions, i.e., items correct were placed at a right angle to items scored as incorrect.

Following each session the Experimenter filled in a score sheet identical to the one used by the observer. Scores for each subject were compared and inter-observer agreement was 100%. The Principal Investigator who served as the observer made the final decisions as to correctness of responses. The Experimenter presented the following instructions to the student, "I am going to show you some words which I have printed on these cards. I will show you one word at a time. If you know the word say it. If you don't know the word say 'I don't know' and we will go on." The Experimenter then presented one of the stimulus cards. The word was exposed for 3 to 5 seconds. If the student did not respond as directed within the 3 to 5 second interval, the Experimenter scored an incorrect response. This procedure was followed until all 10 cards had been presented to each student.
Assignment of Subjects to Groups

Because of the small sample size, random assignment to groups was not feasible. After the total sample was identified (N=30) all boys' names were listed in one column and all girls' names in another in alphabetical order. The first name on each list was assigned to Experimental group A, the second to Experimental group B, and the third to the Control group C. The procedure was repeated until five subjects had been assigned to each of the three groups.

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Boys</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n)</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>(\bar{x}) age</td>
<td>5.3</td>
<td>5.6</td>
<td>5.5</td>
<td>5.46</td>
</tr>
<tr>
<td><strong>Girls</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n)</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>(\bar{x}) age</td>
<td>5.4</td>
<td>5.5</td>
<td>5.7</td>
<td>5.53</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n)</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>(\bar{x}) age</td>
<td>5.35</td>
<td>5.55</td>
<td>5.60</td>
<td>5.49</td>
</tr>
</tbody>
</table>

Limitations

The subject sample studied was drawn from two classes of regular kindergarten students. The limitation of the sample was based on the following rationale: (1) The formal classification and assignment of students to learning disability classes seldom occurs until
after the kindergarten year. (2) The main dependent variable (test of word recognition) was administered as a pretest and required presentation before subjects had had any exposure to formal reading instruction. (3) The main independent variable involved teaching word recognition skills and also required that subjects had had no prior school reading instruction.

Since no data were available indicating the relationships which might exist between olfactory processing and other variables such as sex, age, IQ, socioeconomic status or learning capacity, no stringent attempt was made to control these and other unknown extraneous variables for this preliminary study. An additional limiting factor was introduced because of the nature of the treatment stimuli. In order to present words with olfactory stimuli, it was necessary to select only those words for which microfragrance labels were available in small quantities. The usual marketing procedure required that labels be purchased in minimum quantities of 50,000. The resulting cost of selecting even twenty different labels at random would have been prohibitive. There were, however, ten labels currently available in small quantities at a nominal cost. Therefore the words represented by these labels were utilized during treatment. The commercially prepared fragrance labels were desirable since their use permitted standardization of stimuli over time and for different subjects.
B. Treatment Procedures

Instructional procedures were initiated on the first school day following assignment of students to groups.

Setting. The instructional sessions were conducted in a vacant room provided by the building administrator. The Experimenter met the two experimental groups in small group instructional sessions. Five desks and chairs were arranged to permit a semicircular arrangement of five subjects facing the Experimenter. Each session lasted 10 to 20 minutes. Sessions occurred daily for a period of 20 instructional days. When a subject was absent he/she received an individual make-up session. No subject participated in more than two instructional sessions per day.

Operational Procedures

Experimental Group A (olfactory, visual and auditory stimuli, N = 10). During treatment sessions the presentation of stimulus items to subjects in group A occurred as follows:

(1) First week - The Experimenter had 5 prepared sets of 10 3 x 5 cards each containing one microfragrance label in the form of a pictured object. The Experimenter escorted the five subjects to the designated treatment room for small group instructional session. The Experimenter said "I am going to show you some pictures on these cards." The Experimenter placed one card before each subject. "If you scratch the picture you can smell it. It smells like ___________ (whatever the scent represented). I want each of you to point to the picture and tell me what it is. If you
"don't know, I will tell you." Subjects were to point to pictured object and name it. The Experimenter then said, "Now scratch the picture and sniff it." The Experimenter demonstrated. Each child then scratched the picture and sniffed it. The Experimenter said, "Now tell me again the name of the picture." The Experimenter repeated this procedure with each of the 10 stimulus cards. Each subject repeated the word twice. After the first presentation each card was shown again and the Experimenter said, "Tell me the name of this object again."

Each subject repeated the word while looking at the pictured object. A total of three responses per word/per subject were given.

(B) Second week - The Experimenter had 5 prepared sets of 10 cards each containing a scented label and the written word corresponding to the pictured object (label). The presentation of stimulus cards was identical to Week 1. Cards containing a word and picture were placed before each subject one at a time. Each subject was told to "point to the word on the card. This is the name of the picture. This is how it looks when we write the name. Say the name of the picture." Subjects said the word while pointing to the word. After the first presentation, the cards were shown again. The Experimenter said, "Sniff the label and say the word." Each child sniffed the label and repeated the word. The Experimenter said, "Now point to the word and say it." Each subject repeated the word while pointing to it. This procedure was repeated for each of the 10 words. Each subject
made three responses per word during each session of Week 2.

(C) Third week - 5 sets of 10 3 x 5 cards each containing one word and the scented label were prepared. The Experimenter placed the first card in front of each subject and said, "Sniff the label and say the name of the object." Subjects sniffed the label and repeated the word. The Experimenter then said, "Now point to the word and say it." Subjects pointed to the word and repeated the word. This procedure was followed for each of the 10 words. The order of the cards was then changed and one card was again placed before each subject. The Experimenter said, "Now point to the word and say it again." Subject repeated the word while pointing to it. Each subject made three responses during each session.

(D) Fourth week - 5 sets of 10 word cards were prepared. During the first three days of Week 4 the following procedure was used. The Experimenter placed one card before each subject and said, "Point to the word and say it." If any subject did not recall the word the card used in Week 2 (olfactory cue) was re-presented. After presentation of the olfactory cue the subject was again asked to respond to the word alone. This procedure was repeated for each of the 10 words. The cards were then re-ordered and the procedure outlined above was repeated. The cards were presented in this manner until each subject had given four responses to each card. On the fourth day of Week 4 only the word cards were presented. Again each subject was required to give a total of four responses to each word. On the final day of Week 5 the Experimenter met each subject
individually and presented each of the 10 word cards once. This constituted the posttest and was presented to all three groups in the study. The Observer again monitored all posttest sessions following the same procedures utilized during pretesting.

Experimental Group B (visual and auditory stimuli only, N = 10). Procedures for presentation to this group were identical to those for group A with the exception that no olfactory stimuli were presented.

(A) First week - The Experimenter presented stimulus cards containing the pictured object. Subjects were asked to point to the picture and say its name. Procedures were repeated until each subject responded three times to each pictured object.

(B) Second week - The Experimenter presented stimulus cards containing the pictured object and the word. Each subject was asked to name the picture. The Experimenter provided the same explanation regarding the printed word as was done for group A. Subjects were then asked to point to the word and say it. This was repeated until each subject responded three times to each stimulus during each session of week 2.

(C) Third week - The Experimenter presented stimulus cards containing the word only. Each subject was asked to name the word while pointing to it. If a subject was unable to recall the word, the Experimenter presented the card containing that word and the pictured object. This procedure was followed until each subject had given three responses to each word card presented in random order.
(D) Fourth week (through day 3) - The Experimenter followed the same procedures as in week 3. On day 4, the Experimenter presented word cards only. Each subject was asked to give 4 responses to each of the word cards presented in random order. On day 5 the Experimenter and Observer met with each subject in group B individually and presented the ten words once as the post-test.

Control Group C (no intervention, N = 10). Subjects assigned to the control group participated in the pre and post test presentation of the word cards only. No attempt was made to control for other classroom variables except to request that the teacher avoid any instruction which would include the same stimulus items that were being presented during the study (i.e., microfragrance labels and/or instruction on specific words being used in the dependent measure).

C. Analysis of Data

In order to determine whether there were any statistically significant differences among groups due to the effects of treatment, appropriate statistical procedures were performed. Subjects' gain scores on a test of word recognition administered as a pre and post measure were obtained by subtracting the pretest scores from posttest scores.

Although the data obtained met the level required for parametric analysis of variance, the small sample size violated the assumption of normality of distribution of the dependent variable
and the selection procedures violated the requirement of randomness (Ferguson, 1971, p. 139). Seigel (1956, p. 174) provided an alternate non-parametric test which permitted wider generalization of findings by avoiding the required assumptions of the F test. The data were converted to ranks and analyzed using the Kruskal-Wallis one way analysis of variance by ranks. Since the three groups were considered to be independent and the reading scores were considered to be at least ordinal, the Kruskal-Wallis test was appropriate for testing the null hypothesis, Ho (Seigel, 1956, p. 184, 186). An obtained difference which was equal to or less than \( p \leq .05 \) was accepted as constituting statistical significance. In order to locate the source of obtained differences among the three groups, a non-parametric alternative to the t test was required. The Mann Whitney U test was applied to between-group comparisons. Data were analyzed using the formula for large samples (\( N = 9-20 \)) to accommodate the relatively large number of tied scores. Resulting U values were transformed to z scores and compared to the z table to determine significance (Siegel, 1956, p. 124).
CHAPTER III

RESULTS OF THE STUDY

In this study an attempt was made to show that reading instruction, which included use of olfactory stimuli, would significantly increase word recognition skills of kindergarten students. Three groups were compared: 1) Those who received olfactory, visual, and auditory stimuli, 2) those who received only visual and auditory stimuli, 3) and those who received no instruction.

Kindergarten children who participated in the study were drawn from two schools on the basis of criteria described in Chapter II. A test of word recognition was administered as a pretest to 30 subjects. Initially 10 subjects were assigned to each of the Experimental groups (A and B) and to the Control group (C). At the time of posttesting, two subjects from group C had moved, two subjects from group B and one from group A were absent. In order to equalize the number in each group, another subject from group A was dropped. The child dropped was selected because he had missed 9 of 20 treatment sessions. As a result of subject attrition, complete data were available for only 24 of the original 30 subjects. Table 2 presents a description of the total sample by group, subject characteristics and performance on the pre and post test instrument.
TABLE 2
MEANS FOR AGE, SEX AND PERFORMANCE DATA
OF SUBJECTS COMPLETING
THE STUDY (N=24)

<table>
<thead>
<tr>
<th>Group</th>
<th>Age (X)</th>
<th>Sex (M, F)</th>
<th>Pretest (X)</th>
<th>Posttest (X)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>5.4</td>
<td>3, 5</td>
<td>0</td>
<td>3.12</td>
</tr>
<tr>
<td>(Olfactory, Visual &amp; Auditory, n=8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group B</td>
<td>5.5</td>
<td>5, 3</td>
<td>0</td>
<td>4.37</td>
</tr>
<tr>
<td>(Visual &amp; Auditory Only, n=8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group C</td>
<td>5.6</td>
<td>5, 3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(Pretest, Posttest Only, n=8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This chapter is divided into two main sections. The first contains a description of the statistical analysis and results which relate to each of the null hypotheses. The findings are discussed in the second section.

Analysis of Total Group Performance

In order to determine whether any statistically significant differences existed among the mean scores of subjects receiving olfactory, visual and auditory stimuli, those receiving only visual and auditory stimuli and subjects in the Control group, the following statistical analysis was employed. Word recognition scores, resulting from administration of the posttest to the total sample,
were combined. The Kruskal Wallis one way analysis of variance by ranks was applied to the data. A statistically significant $H$ value of 15.96 was obtained ($df=2, p<.001$). Hypothesis 1 was therefore found untenable (see Table 3).

### Table 3
RESULTS OF STATISTICAL ANALYSIS FOR TOTAL GROUP UTILIZING THE KRUSKAL WALLIS ONE WAY ANOVA BY RANKS (N=24)

<table>
<thead>
<tr>
<th>Groups</th>
<th>$H$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+B+C</td>
<td>15.96</td>
<td>$p&lt;.001$</td>
</tr>
</tbody>
</table>

Because the analysis of the data using the Kruskal Wallis test only disclosed that a statistically significant difference existed among the groups, it was necessary to apply a non-parametric alternative to the $t$ test to locate the source of difference. The Mann Whitney $U$ test was applied to determine which groups differed significantly. The $U$ value was then transformed using the $z$ formula (Seigel, 1956, pp. 116-124). This procedure was necessary to accommodate the number of tied scores among the data.

Individual comparisons among each of the three groups were made using the procedures outlined above.
Group A x Group C

Comparison of the subjects' scores who received olfactory, visual and auditory instruction (group A) versus those who had received no instruction yielded a statistically significant difference in favor of group A \((U = 0, p < .01)\). Therefore, Hypothesis 2 was found to be untenable. Even though the Control group spent more time in class, they did less well on the dependent measure than did the olfactory group. Children who received auditory, visual and olfactory stimuli were able to recognize more words at the time of the posttest than were those who received no instruction.

Group B x Group C

An identical comparison was made between subjects who received instruction utilizing auditory and visual stimuli and those in the Control group. The resulting \(U\) value = 0 was statistically significant at \(p < .01\); therefore, Hypothesis 3 was found to be untenable. Children who received instruction on sight words using visual and auditory stimuli were found to perform significantly better than those in the Control group on a test of word recognition.

Group A x Group B

When the scores of subjects in the two experimental groups were compared statistically, the resulting \(U\) value of 43 was not statistically significant \((z = 1.15, p > .05)\). Hypothesis 4 was, therefore, found tenable. The addition of olfactory stimuli in conjunction with sight word instruction did not significantly
increase subjects' performance over those who received only visual and auditory stimuli. Subjects' performance following either method of instruction did not demonstrate any support for utilizing one method over the other. Table 4 summarizes the data analysis between groups.

**TABLE 4**

**MEAN SCORE DIFFERENCES BETWEEN GROUPS**

**UTILIZING THE MANN WHITNEY U TEST**

<table>
<thead>
<tr>
<th>Groups Compared</th>
<th>U</th>
<th>z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A vs. Group C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olfactory, Visual &amp; Auditory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-Posttest Only</td>
<td>64</td>
<td>3.36</td>
<td>*p &lt; .01</td>
</tr>
<tr>
<td>Group B vs. Group C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auditory &amp; Visual</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-Posttest Only</td>
<td>64</td>
<td>3.36</td>
<td>*p &lt; .01</td>
</tr>
<tr>
<td>Group A vs. Group B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olfactory, Visual &amp; Auditory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auditory &amp; Visual</td>
<td>43</td>
<td>1.15</td>
<td>+p &gt; .05</td>
</tr>
</tbody>
</table>

*z = 2.58 = p < .01
+z = 1.96 = p < .05

**Discussion**

The finding that kindergarten children who are subjected to intensive short term instruction were able to learn a limited number
of words while those who were not taught failed to recognize the same items was not an unexpected outcome. The comparison was necessary only as a means to control for any learning of the items on the dependent variable which might have occurred incidentally and thus have been erroneously attributed to the effects of treatment. The finding might serve as support to other investigators who have been concerned with age variables with respect to readiness for formal reading instruction (Englemann, 1969, Cawley et al, 1972, p. 73), or those who have responsibility for planning kindergarten programs. A question implicit in the first null hypothesis was whether acquisition of reading skills at the beginning kindergarten level was possible. The high level of significance of the differences found between control subjects and treatment subjects thus supports early reading instruction for the kindergarten children in the sample.

The major question asked in the study was not whether five year olds could learn to read, but whether the addition of another modality of input would significantly accelerate acquisition of sight words. The subjects in group A received instruction which provided them with opportunities to associate olfactory cues (scratch and sniff labels) with pictures and subsequently with words. Their counterparts in group B received identical stimulus items with the exception that they were unable to utilize the olfactory properties of the pictures since their cards were laminated.

It was expected that the olfactory cues would enable children in group A to form mnemonic associations which would facilitate
recall of the word after the olfactory cues were removed. A comparison of the performance of the two groups failed to support that expectation. Subjects receiving only visual and auditory cues were able to recall an average of 4/10 words on posttest while those in group A achieved an average of 3/10.

Not only did the addition of olfactory cues fail to produce greater gains but subjects receiving olfactory stimuli were slightly lower in performance when compared to those who received more traditional instructional methods. However, it should be noted that their performance was significantly higher than the Control group. While statistically the difference between groups A and B was not significant (p=.06) it did approach significance. One variable which was observed during treatment may have accounted in part for the obtained results. Those children who comprised group B were generally more amenable to the structure imposed during treatment. They were better able to sit at the table quietly, attend to tasks, and follow directions. Hops and Cobb (1973) have shown that reading scores increased as a result of improved task-related behaviors. The uncontrolled selection variables may thus have contributed to the results. A finding of this sort would raise a question regarding the usefulness of olfactory stimulation with children who typically are found to have difficulty in learning to read. If task-related behaviors are known to be a major prerequisite for reading then it would appear that for this sample the olfactory stimuli were not sufficiently motivating to sustain subjects' attention.
Another artifact of the study was the condition under which treatment occurred. In order to determine whether individual make-up sessions may have accounted for differences in favor of group B, the number of sessions per group were reviewed. Comparisons were also made between the number of sessions and individual scores on the posttest. In group A, 5 subjects missed a combined total of 13 sessions. In group B, 6 subjects missed the same number of sessions. With the exception of two subjects, one in group A, one in group B, those children who missed sessions and subsequently received individual instruction scored lowest on the posttest. Therefore it can be assumed that individual sessions did not inflate either groups' performance on the dependent variable.

The impact of using olfactory stimuli as an aid to reading skills acquisition remains questionable. The olfactory group's performance was clearly superior to the control group's, thus demonstrating the feasibility of teaching beginning readers through the olfactory mode. The olfactory stimuli may have aided in initial learning of the verbal labels (names of pictured objects) but not the written word. The subjects in group A did attend to the olfactory properties of the stimulus cards and some were later observed smelling the word card when they couldn't recall the word alone. The novelty of the olfactory labels was short-lived despite the fact that none of the subjects had had prior experience with scratch and sniff labels. This was shown when they had to be taught how to activate the fragrance by scratching the surface of the pictures.
The initial excitement with the stimuli continued through the first week only. This was not unexpected since each child was exposed to the stimuli 150 times per week.

Summary:

Analysis of the data resulting from the study has failed to provide conclusive evidence that presentation of information through the olfactory modality enhanced learning of sight words for the kindergarten subjects selected for the study. Teaching did significantly effect the performance of both experimental groups as compared to controls but the difference between treatment groups was not significant.

A number of uncontrolled variables may have confounded the results. The selection process for assigning subjects to groups apparently provided unforeseen differences in the groups' task-oriented characteristics. While the olfactory modality may be a factor in learning as Bilenker (1967) and Stephens (1970) suggest, the manner in which it is utilized by students remains unclear.
CHAPTER IV
SUMMARY

Research into the complex process of reading has occupied the interests of many educators (Harris, 1961, Johnson and Myklebust, 1967). As individualized instruction and an emphasis on individual learners' characteristics has become more prominent as an issue in educational practice, the interest in learning modalities has increased (de Hirsch, Jansky and Langford, 1965, Bateman, 1968). The modalities believed to be most involved in the reading process have provided the focus of numerous experimental studies. Dykstra (1966), Doehring and Rabinovitch (1969), Budhoff and Quinlan (1964) and Bateman (1968) are representative of those who have studied the importance of the auditory modality and reading. Hammill (1972), Buckland and Balow (1973) and Sabatino and Streisguth (1972) have focused on the visual modality. More generalized approaches to the modality issue were conducted by classifying reading instruction according to the modality emphasized to determine the relative effectiveness of the different approaches (Oakland, Harmer and Williams, 1973).

The literature was lacking with respect to experimental research involving the olfactory modality as an adjunct to reading instruction. Three authors had suggested procedures for
incorporating the olfactory sensory modality with academic learning (Bilenker, 1967, Edgington, 1968 and Stephens, 1970), but no research data had been gathered to test the procedures. The present study was implemented in an attempt to partially fill that gap in the literature.

The specific purpose of this preliminary study was to determine whether initial pairing of olfactory cues with words to be learned would increase later word recognition among beginning kindergarten students.

The rationale for selecting kindergarten students to participate in the investigation was based on two related concerns: 1) Although much of the modality research had been conducted with learning disabled subjects, the nature of the dependent measure required experimenting with subjects who had no opportunity for prior formal teaching, and 2) children are seldom identified for special class placement until well after the kindergarten year. Initial selection of 30 students to participate in the study was determined by their performance on the pretest measure.

A list of words was selected for which microfragrance labels were commercially available. The instructional method was differentiated on the basis of olfactory cues. The same list of words constituted the pre and post test measure. Instructional procedures were defined for daily sessions for each of the Experimental groups as well as for administration and scoring of the dependent measure.

Following the pretest, subjects were assigned to one of two Experimental groups or to the Control group. Subjects in
Experimental group A received instruction which utilized olfactory, visual and auditory cues while Experimental group B received the same instruction without olfactory cues. The Control subjects only participated in the pre and posttesting. Performance scores following treatment and administration of the posttest measure were submitted to statistical analysis.

The following hypotheses were submitted to statistical analysis:

$H_0_1$: There will be no statistically significant difference $(a=.05)$ among the means of Experimental group A who receive instruction utilizing visual, auditory and olfactory stimuli, the mean of Experimental group B who receive instruction utilizing only visual and auditory stimuli and the mean of Experimental group C who receive no instruction, on a test of word recognition.

This hypothesis was found untenable $(p<.001)$.

$H_0_2$: There will be no statistically significant difference $(a=.05)$ between the mean of Experimental group A, due to the effects of instruction utilizing visual, auditory and olfactory stimuli, and the mean of Control group C who received no instruction on a test of word recognition.

Hypothesis 2 was found untenable $(p<.01)$.

$H_0_3$: There will be no statistically significant difference $(a=.05)$ between the mean scores of Experimental group B due to the effects of instruction utilizing
visual and auditory stimuli and the mean scores of Control group C who receive no instruction on a test of word recognition.

Hypothesis 3 was also found to be untenable at \( p < .01 \).

**H04:** There will be no statistically significant difference (\( a = .05 \)) between the mean of Experimental group A due to the effects of instruction utilizing visual, auditory and olfactory stimuli and the mean of Experimental group B who receive instruction utilizing only visual and auditory stimuli, on a test of word recognition.

The results of analysis of scores between Experimental groups failed to reach statistical significance; therefore, Hypothesis 4 was found tenable (\( p > .05 \)).

The results indicated that statistically significant differences did exist among the means of the two Experimental groups who had received two different methods of instruction and the Control group who had received no instruction (\( p < .001 \)). Comparisons between each Experimental group and the control subjects also resulted in statistically significant findings (\( p < .01 \)). However, no statistical significance was found when subjects who had received olfactory, visual and auditory cues were compared to those who had received only visual and auditory stimuli (\( p > .05 \)).
Conclusions

The limitations of the present study do not permit generalizations to other than the sample population selected. The absence of strong evidence either for or against the use of olfactory stimuli suggests that at least under the conditions operative during treatment, variables other than olfactory cues produced the learning which was demonstrated on the posttest. The raw scores obtained appeared to favor the instructional method which dealt with auditory and visual stimuli only. This finding may reflect that the use of multi-modal treatments are only effective when the modalities are directly involved with the language function (Johnson and Myklebust, 1967). Since the subjects were assigned to the Experimental and Control groups on the basis of reading performance, it does not address the question raised by Stephens (1970). That is, do students who demonstrate, upon assessment, a facility to discriminate olfactory stimuli well learn rapidly through that sensory channel?

Recommendations

Some suggestions for future research into the issue of olfactory stimuli and academic learning are:

1) Olfactory cues should be presented in a different format to eliminate the visual representation. Because the scratch and sniff labels were prepared in the color and form of the objects they represented, the possibility exists that the children relied more on color or picture cues to identify the word.
2) The study should be replicated by having all subjects participate in both treatment methods by presenting half of the words to be learned with odor cues and half without. Such a procedure would nullify the effects of selection bias noted earlier in the present study.

3) It would also be helpful to investigate the usefulness of the olfactory modality in reading with different types and age groups of students, e.g., blind and partially sighted or primary and intermediate EMR and LD students. Cawley et al (1972, p. 146) reports that there is evidence that young children are unable to relate information from different sensory inputs over time and space. Research data are needed to determine whether this applies as well to older children who are perceptually limited.

4) The issue of learning through the olfactory mode should be studied with children who demonstrate above average discrimination of odors.

5) In order to permit wider generalization of the effects of olfactory stimuli this study should be replicated with larger samples.

Many children encounter frustration and failure as they attempt to learn to read. Even that research which results in negative or inconclusive findings serves to extend the scope of knowledge regarding the reading process; it frees us to direct attention to other variables and/or other more fruitful issues.
Appendix A

Individual Stimulus Items
tree

rose
strawberry

peach
orange

grape
chocolate

candy
cheese

apple
tree

rose
strawberry

peach
orange

grape
chocolate

candy
cheese

apple
Appendix B
Individual Student Data Sheets

STUDENT DATA SHEET

STUDENT: C. L.  
GROUP ASSIGNMENT: A - 1  
EXPERIMENTER: Cheryl Elsberry  
OBSERVER: A. Carol Hartman  
CRITERION: 12/13

PRE TEST DATE: 3/13/74  
PRE TEST SCORE: 0/10  
POST TEST DATE: 10/14/74  
POST TEST SCORE: 1/10

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**GROUP ASSIGNMENT** A-1  
**EXPERIMENTER** Cheryl Elsberry  
**OBSERVER** A. Carol Hartman  
**CRITERION** 10/10

**PRE TEST DATE** 3/13/74  
**PRE TEST SCORE** 3/10  
**POST TEST DATE** 10/11/74  
**POST TEST SCORE** 3/10

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GROUP ASSIGNMENT  A - 1           PRE TEST SCORE  0/10

EXPERIMENTER  Cheryl Elsberry     POST TEST DATE  10/11/74

OBSERVER     A. Carol Hartman      POST TEST SCORE  7/10

CRITERION     10/10                 

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**OBSERVER**  A. Carol Hartman  
**CRITERION**  10/10

**PRE TEST DATE**  9/11/74  
**PRE TEST SCORE**  9/10  
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GROUP ASSIGNMENT  A - 2   PRE TEST SCORE  5/10
EXPERIMENTER  Cheryl Elsberry   POST TEST DATE  10/11/74
OBSERVER  A. Carol Hartman   POST TEST SCORE  2/13
CRITERION  10/10

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**STUDENT** W. L.  
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**OBSERVER** A. Carol Hartman  
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GROUP ASSIGNMENT  B - 1  
EXPERIMENTER  Cheryl Elsberry  
OBSERVER  A. Carol Hartman  
CRITERION  10/10  

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GROUP ASSIGNMENT  3 - 1        PRE TEST SCORE  9/10

EXPERIMENTER  Cheryl Elsberry    POST TEST DATE  10/11/74

OBSERVER    A. Carol Hartman    POST TEST SCORE  7/10

CRITERION  10/10

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**OBSERVER** A. Carol Hartman  
**CRITERION** 10/10  

**PRE TEST DATE** 9/13/74  
**PRE TEST SCORE** 0/10  
**POST TEST DATE** 10/11/74  
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EXPERIMENTER  Cheryl Elsberry
OBSERVER   A. Carol Hartman
CRITERION  10/10

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**STUDENT** Y. C.  
**GROUP ASSIGNMENT** B - 2  
**EXPERIMENTER** Cheryl Elsberry  
**OBSERVER** A. Carol Hartman  
**CRITERION** 10/10

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**OBSERVER** A. Carol Hartman  
**CRITERION** 10/10  

**PRE TEST DATE** 9/11/74  
**POST TEST DATE** 10/11/74  

**PRE TEST SCORE** 9/10  
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OBSERVER  A. Carol Hartman  
CRITERION  10/10  
PRE TEST DATE  9/13/74  
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**OBSERVER** A. Carol Hartman  
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BIBLIOGRAPHY


Galton, F., 'Arithmetic by smell.' Psychological Review, 1894, 1, 61-63.


