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THE UTILIZATION OF ODOR PREFERENCES AS REINFORCERS FOR ACADEMIC TASKS WITH YOUNG LEARNING DISABLED CHILDREN

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

Thomas Wesley Frew, A.B., M. Ed.,

* * * * * * * *

The Ohio State University

1975

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Approved by

Adviser
Faculty for Exceptional Children
TO DAWN AND CHRISTOPHER

My constant multi-modality
   - reinforcers -
ACKNOWLEDGEMENTS

I would first like to thank Dr. Thomas M. Stephens, my major adviser, for his encouragement and support throughout my doctoral program, and for the direction he has given me during this study. Special thanks are due to Dr. John O. Cooper for his positive and constructive suggestions on data collection and on the design used. For their support and understanding, I also wish to thank Dr. Raymond Swassing and Dr. W. Frederick Staub.

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To Dawn and Christopher who provided love and support at all times I wish to give my very special thanks. My appreciation to all my friends for their encouragement, and a final thanks to my parents without whom none of this would have been possible.
**VITA**

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Major Field: Learning and Behavior Disorders.
Professors Thomas M. Stephens and John O. Cooper.
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CHAPTER I

INTRODUCTION

Vision, hearing, touch and olfaction are sensory inputs that may set the occasion for acquisition and maintenance of learned behavior. Osgood (1957) calls these the receptive modes of modalities by which an individual receives sensations from the environment in order to assimilate information. Visual, auditory, haptic, and olfactory modalities meet White's (1972, p.165) definition of stimuli:

All objects and events in our environment... that we are aware of, only inasmuch as they stimulate our senses. Generally we refer to an object or event as a stimulus if it occurs prior to or simultaneously with the response.

White further clarifies his definition:

If the object or event occurs after the response, and has been demonstrated to affect the rate of responding, then we refer to it as a reinforcer.

Madsen and Madsen (1974, p.209) define stimulus as "an environmental event." They define reinforcement as the "contingent use of stimulus resulting in an increase or maintenance of behavior."

Visual and auditory sensations serve as social stimuli and reinforcers. Television sets provide visual and auditory stimuli, and watching the sets seems to be a reinforcing activity because there are sets in almost
every home today and these sets are watched daily by millions of people. Movies also utilize seeing and hearing stimuli, and people continue to desire these environmental events as evidenced by the number of people who attend movies. Studies relating to specific modality learning have consistently dealt with the visual, auditory, and haptic channels (Birch and Belmont, 1964; Hurley, 1968; Schevill, 1971, Deutich, 1972; Hammill, 1972; and Waugh, 1973).

Ensminger (1970) discussed his model of stimuli reception. He proposed an input-output system. The input system involves auditory-verbal events, and the output system consists of verbal-motor activities. Ensminger's system does not include the olfactory modality. He is not alone in his exclusion of this mode of learning. The sense of smell is rarely referred to in education. Stephens (1970) discussed the olfactory mode and outlined assessment techniques using the sense of smell, but most authors neglect this area.

Teaching has most often relied upon the visual and auditory modalities. This is evidenced by the plethora of visual and auditory devices exhibited in any classroom. For example, the visual and auditory stimuli have been successful in most instances as children have continued to learn, in other words, their behavior has been increased
or maintained. The visual and auditory modalities are then serving as stimuli and as reinforcers if one looks at the process of learning in very broad terms. For the normal child to learn, responses must be reinforced whether the behavior relates to reading, math, science or other academic and social disciplines.

Dunn (1967) states that children with learning problems have been labeled in many different ways. They have been called hyperactive, neurologically impaired, perceptually disordered, and psycho-neurologically impaired. The labels have not improved the learning of these children, as many of them are not learning basic skills and concepts. The labels are certainly only one component of the individual child's problem as there may be biological and/or environmental conditions that enhance or even cause the problem. The labels however, certainly are not a positive aspect of the child's life.

Man's sense of smell is very important to his existence. As Amoore (1970, p.xi) states, "On our humble nose depend our appetite, comfort, pleasure, and sometimes our life." Most of the products we use in daily life have a specific smell. Many times the way a product smells will make it more attractive. The consumer may buy one product instead of a similar product because of the odor
difference. There may be other variables involved in this process such as brand name and advertising procedures, but this process can be defined as consumer or individual preference.

Individual preference is a complex and an unclassifiable topic if looked at in general terms. There is no one preference that can be stated as reinforcing to all. White (1972, p.110) however, defined preference as "the probability that an organism will emit one behavior to obtain one reinforcing event as opposed to another behavior to obtain another reinforcing event."

Newspapers, magazines, radio and television advertisements are telling the public how we, certain products, and the general atmosphere should and should not smell. There is no definite odor preference for all. Many products with different odors are selling in equal quantities. This fact only points out that individuals are different, and that they have different likes and dislikes. The one exception might be the lemon smell. This odor appears to have a very reinforcing effect because of the great variety of commercial products which are available that possess this odor: soap, perfume, cosmetics, deodorants, oven cleaners and even cigarettes.

Physical scientists have done research in relation
to the olfactory modality (Paschal, 1952; Michels, Phillips, Wright and Pustek, 1962; Tanyolac, 1968), but educators have almost completely ignored the sense of smell in teaching and research. Schachtel (1959) discussed the reason for this being that smell is truly a primitive and animalistic modality. Many non-Western countries rely heavily on human scents for pleasure. Western cultures have tried to sterilize all human scents and have indoctrinated our society into believing that many human odors, such as those produced by the sweat glands, are repugnant and must be eliminated, or at least covered by some "refreshing odors." This point is exemplified by the absence of descriptive words relating to the process of smelling in the English language.

An infant knows and remembers how his mother smells and tastes before he knows and remembers how she looks (Schachtel, 1959). Early research relates the importance of the sense of smell in infancy and early childhood, finding that the child judges people and objects largely by scent (Groddeck, 1934). If the way we smell is so important, and if children discriminate odors at such an early age, then why is the use of smell for educational purposes so neglected in schools and in research? The reason for this could be a lack of interest or lack of knowledge of the olfactory modality in a school setting.
Also, if smell is reinforcing, what are the odors most preferred by individuals, especially young children who have learning problems? There are too many different odors for one study to test, but several representative odors could be used for trial studies of odor preferences.

STATEMENT OF THE PROBLEM

There may be many children in school who are not learning because they are being instructed through only visual and auditory channels. Another aspect to consider in the teaching of children is that reinforcement is generally administered verbally or visually. The teacher usually says, "Very good," smiles at the child or gives a grade to the work completed. For some children, these stimuli may not function as reinforcers.

If the sense of smell is to be utilized as a consequence of behavior, then procedures should be developed for identifying or assessing potential odor reinforcers. Researchers have not identified odor preferences. There have been classifications of odors, but the area of odor preference has been left primarily to the cosmetic industries, and this information has not been related to education in any form. Since the olfactory modality is important to our existence, then there may be odor preferences that could be used as reinforcers in certain
teaching/learning situations with children.

The purpose of this study was to answer the following two research questions:

**QUESTION I**

Will subjects demonstrate a preference for an odor over a non-odor?

**QUESTION II**

If an odor preference is demonstrated, will the odor function as a reinforcer for academic work?
CHAPTER II

REVIEW OF LITERATURE

Literature pertaining to the study of olfaction is sparse in educational research. Therefore, this review is divided into four sections. Part I deals with the sense of smell as related to authors, novelists and their opinions and fictionalized usages. Part II discusses the medical-scientific aspects of olfactions and the process of smelling. Part III discusses the use of related modalities in education, and Part IV reviews the research of olfaction in education. Each section is summarized to note the contributions made by the group discussed.

FICTION AND OPINION

Authors and novelists have been fascinated by the sense of smell for hundreds of years. Levitas (1963) edited a two volume series on The World of Psychology the first volume dealing with perception, man and his emotions. The writings in this book related to the olfactory sense reveal many authors who had explored the sense of smell and had used this modality in their writings. Levitas stated that Aristotle was the first known writer to hypothesize that the development of
reason in man is coincident with a decline in the utilization of the senses of smell and taste as ways of understanding the world. Huysmans (Against the Grain, 1931) used the sense of smell to arouse violent imagery in his central character. O. Henry (The Furnished Room, 1953) allows his hero to become a victim of the emotions he has stirred up by his sense of smell. Joyce (Portrait of an Artist as a Young Man, 1928) and Whitman (Leaves of Grass, 1943) dwell upon the powerfulness of smell and the effect it produces in human behavior.

Helen Keller (1908) points out the use of smell in relation to memory:

Smell is a potent wizard that transports us across thousands of miles and all the years we have lived. The odors of forests wafts me to my southern home, to my childhood frolics in the peach orchard. Other odors, instantaneous and fleeting, cause my heart to dilate joyously or contract with remembered grief. Even as I think of smells, my nose is full of scents that start to awake sweet memories of summers gone and ripening grain fields far away (p. 23).

SUMMARY

This is but a small sample of the references to smelling found in literature. Pornographic writings make countless references to the function of smelling in a variety of sexual stimulations. Authors have used the sense of smell in their writings to further stimulate their characters motivation and to provide another depth
of involvement for the reader.

MEDICAL-SCIENTIFIC ASPECTS OF OLFACITION

In order for one to smell, there must be an odor present for the process of smelling to occur. The early problem for scientists was to determine odor classifications.

The earliest recordings of odor classification, according to Harper, Smith and Land (1968, pp. 19-20) began with Aristotle who tended to combine odor and taste. Harper et. al. (1968) state that Linneaeus established the first series of odor classifications. The seven classifications were aromatic, fragrant (both pleasant) ambrosial (musk-like), alliaceous (garlic-like), hircine (goat-like), foul and nauseating (unpleasant and disgusting). Even in these early writings Linneaeus was conscious of odor preference as he stated that ambrosial and hircine odors are pleasant to some and unpleasant to others.

Odor classifications were increased in number by Zwaardemaker in his studies from 1895 to 1925. In his studies, he looked for the principal and most elementary smell sensations. Harper, et. al. (1968) in reviewing the volumes of work state:

Zwaardemaker made a number of highly pertinent general observations on odor description and odor classification. He drew attention to the
fact that odors have no "Proper Names" and are usually named after the substances that gave rise to them. He compared the position of odor classification at the end of the nineteenth century with that of classifying colors before Newton had developed his analysis of color in the sun's spectrum. In that pre-scientific era colors were identified and named in terms of what Zwaardemaker referred to as 'universal images' thus suggesting that red was the color of blood, green the color of grass, and so on. It is clear that even today (1965) the study of odor perception is only just beginning to emerge from this pre-Newtonian stage. As Zwaardemaker and others have indicated, we continue to have to speak of the smell of fish, or the perfume of a flower, and so on...(p.27).

Zwaardemaker had thirty odor classifications, and they included fruity, waxy, ethereal, camphor, clove, cinnamon, aniseed, minty, thyme, rosy, citrus, almond, orange-blossom, lily, violet, vanilla, amber, musky, leek, fishy, bromine, phenolic, caproic, cat urine, narcotic, bed- bug, carrion and fecal. Zwaardemaker did extensive studies with all of these odors to such a degree that Boring (1942, p.459) cites him as the person who "really created interest in the psychology of smell."

With the advent of Zwaardemaker's studies, the olfactory modality classification became somewhat more researched. Henning (in Harper, et. al. 1968, p.28) used only six classes of odors: spices, fruity, flowery, burnt, resinous and foul. These followed Zwaardemaker's classes. Crocker and Henderson (1927) cut the classes by two and worked with only four classifications: fragrant,
burnt, caprylic and acid.

One of the problems that these researchers faced was a limitation of descriptive words relating to smell. No matter how diverse their theories may be, they all had to use similar descriptions.

Amoore (1952, p. 325) proposed a stereochemical theory in which he postulated that "odor quality was primarily determined by the requirement of seven basic hypothetical receptor sites for molecules of such an overall shape and size to fit into them." Amoore titled his seven classifications: ethereal, camphor, minty, floral, musky, putrid and pungent. Further research was done following Amoore, and each group came up with different numbers of classifications. Wright and Michels (1964) used eight classes and Harper and his associates (1968) improved on Zwaardemaker in number usage and found 44 odor classifications.

Amoore (1970) attempted to match his stereochemical classifications with those of Linneaeus, Zwaardemaker, Henning, Crocker and Henderson. By using the classes of the older systems, he manages to show a good relationship with the primary odors of the stereochemical theory.

Erb (1968, p.127) takes a more humorous view of the nose, but seriously states that the "olfactory nerve carries its findings directly to the seat of logic."
memory and imagination of the brain." The Russians have researched the olfactory area. Kasatkin (1969, p.95) found that children can differentiate smells at a very early age. He found that children "at the end of two months of life could differentiate two odors." Nemanova (1969) stated that at the end of three months the child is capable of distinguishing one odor from among six others. Kasatkin (1969, p.93) also found that "at the age of two to four months the conditional olfactory reflex is formed rapidly... after twelve to seventeen trials."

There have been, and probably will continue to be, many theories concerning the proper numbers and names of the primary odors. At the present time, there is no general agreement among scientists, because scientists have not positively discovered exactly how the olfactory modality functions. Bedicheck (1960) notes that 176 books on odors have been written in the last century, mostly by Germans, and none of them has come up with a definite answer as to how the nose works.

Amoore (1970) gives a very clear and concise theory on the mechanics of smelling. Amoore, explains the process of smelling this way:
The stream of air drawn in through the nostril is warmed and filtered as it passes the three baggle-shaped turbinate bones or conchal in the upper part of the nasal cavity. When an odor is noticed, more air is vigorously sniffed upward to two clefts that contain smelling organs; two patches of yellowish tissue, each about one square inch in area. Nerve fibers from the olfactory area pass directly through the perforated cribiform plate in the base of the skull, into the olfactory bulb, which is the part of the brain which deal specifically with smelling. Though large in certain animals like the dog or the shark, in many, the olfactory bulb seems almost vestigial compared with the great areas devoted to the dominant human senses of sight and hearing.

Amoore further points out that the olfactory cells contain olfactory hairs that are covered by a thin layer of watery mucus which is supplied by the Bowman glands. Molecules of odorous vapor must leave the air stream and dissolve in the watery layer before they can reach the olfactory hairs.

Erb (1968) describes the process of smelling as electrical in nature. He leans heavily on Amoore's process as he presents three conditions necessary before a substance creates an odor:

1) The material must be volatile, that is the vapor must reach the nasal passages.

2) The odorous substances must be soluble in water and/or fatty material.

3) The chemical substance must have the capacity for being oxidized or reduced. (Oxidation is a loss of electrons and reduction is a gain of electrons) (pp. 128-130).
Erb says that enzymes now work on the odors. In the olfactory spots, the enzymes of oxidation and reduction work to accelerate the rate of odorous gases with the oxygen of the inhaled air and an electrical impulse is triggered. That is the stimulus that allows one to differentiate onions and perfume.

These two theories tend to be somewhat accepted by writers. The nose is and has been of interest and mystery. Curtis, Caldwell and Sherman (1934, p. 43) relate "the striking thing about the olfactory system is its unique structure and development. It is the first of the receptor systems to become a dominant guide to movement of the entire body in vertebrates."

Sinclair (1960, p. 44) emphasizes the mystery of the nose as related to smelling: "It is one of the most intriguing subjects you could choose because of its intangibility, and yet its deep-rooted affective quality... We have been able to reduce color and tone to vibrations, but smell resists analysis."

Theories of olfaction process (Amoore, 1952, 1962; Davis, 1965; Wright, 1964; Dravnieks, 1964) have been accepted, dispelled and discussed, but a definite theory on the operations of the nose is still to be universally decided upon.
SUMMARY

Scientists have been and continue to be confused as to the operations of the nose. However, they are exploring its importance in relation to our existence in our continually changing environment.

RESEARCH OF RELATED MODALITIES IN EDUCATION

In reviewing the research on other modality preferences, visual, auditory, tactile-kinesthetic, the literature is copious, but conflicting. Most of the research was related to listening and reading.

Henmon (1912) concluded that research findings to 1912 were conflicting. The available research in 1912 that compared different modes of learning had conflicting findings which were due to the experimenters' inability to determine and control for different imagery types. Day and Beach (1950) drew specific conclusions from their study of the individual findings of 34 investigations comparing the auditory and visual modes as mediational channels. The major portion of their research indicated the following:

1) A combined presentation produces greater comprehension.

2) An oral presentation is more efficient for presenting meaningful, familiar material, while a visual presentation is best for meaningless,
unfamiliar material.

3) Preference for the visual mode increase proportionately with the intelligence level of the receiver.

4) Preference for the visual mode increase proportionately with the reading ability of the receiver.

5) The auditory mode is preferred by six year olds, with gradual transition evidenced until, by the age of 16, the visual mode is possibly superior.

6) An increase in the difficulty level of material results in a parallel increase in preference for the visual mode.

7) The visual presentation is superior for immediate recall, the auditory presentation for delayed recall.

8) As the interval between presentation and recall is lengthened, the visual presentation becomes relatively less efficient.

9) The visual presentation is strengthened by the fact that any part of it can be referred to again for purposes of re-reading. If the factor of referability is controlled, the relative efficiency of the visual presentation is diminished.

10) When material to be learned is organized and related, the visual mode is superior.

11) Material is easier to learn through the visual channel but better retained when presented via the auditory channel.

McGeoch and Irion (1952), working under the premise that individual differences account for conflicting reports in relation to modality preference, believed these differences to be attributable to four variables: practice,
chronological age, type of material to be learned, and mode of apprehension. Witty and Sizmore (1958, 1959a and 1959b) also looked at the known research comparing oral and visual presentation, their conclusions were:

1) Listening appears to be superior to reading in the early years of childhood.

2) Reading seems to be more effective for adults when the materials require careful or critical analysis.

3) Groups and individuals usually demonstrate high correlations in their ability to learn through different sensory channels.

4) The tasks and the methods of employments and evaluation are significant independent variables.

5) Amount of experience with a particular form of stimulation is a determiner of success in learning.

6) Administering a test in oral or written form produces very little difference in learning.

7) The mode of presentation employed has very little effect on retention.

8) The auditory channel is superior to the visual channel when advertising materials are used.

9) Since a superior mode of presentation cannot be demonstrated except when special factors are operating (e. g. type of materials, method of presentation, and experience and interests of the subjects), further modal comparison studies searching for a superior channel of presentation should be discontinued.

The final suggestion of Witty and Sizemore was not taken as is evidenced by numerous studies that followed.
This suggestion should not be taken because there should never be a time when we stop looking for new ways to help children learn.

Bateman (1968) conducted a study with 182 kindergarten children. She attempted to determine whether the auditory or visual method of teaching reading was superior. The subjects were followed into the first grade and were divided into two groups, auditory and visual preference groups. The Illinois Test of Psycholinguistics (ITPA) served as the instrument for dividing the subjects into the two groups. The visual method employed Scott, Foresman New Basic Readers, and the auditory method used Lippincott Basic Reading Series. Analysis of variance was used in the statistical treatment.

Bateman found that the auditory method produced superior reading and spelling achievement when compared to the visual method. No significant interaction between modal preference and instructional method was found.

It should be noted, however, that neither the Scott, Foresman nor the Lippincott materials used in the study are distinctly visual or auditory in nature.

Jones (1971) examined the relationships among modal preference and two measures of reading achievement, using 90 third grade subjects. This study also utilized only
the auditory and visual learning channels. The modal preference was determined by subtracting the score on the visual task from the score on the auditory task. Upon completion, the Metropolitan Reading was given to the subjects and the modal preference score did not correlate significantly with size of sight vocabulary or reading comprehension. One conclusion drawn from this study was that subjects who exhibit very strong modal preference, regardless of the nature of that preference, might still evidence poorer reading achievement.

De Hirsch, Jansky and Langford (1966) conducted an interesting study that attempted to determine a strong modal preference, either auditory or visual. Unfortunately, no valid conclusions can be drawn because the authors failed to control for different methodologies of teachers. Fifty-three kindergarten children were given four tests of auditory perception (Imitation of Tapped Patterns, Auditory Discrimination, Language Comprehension, and the Gates Rhyming Test) and four tests of visual perception (Bender Visual Motor Gestalt, Horst, Gates Matching and Word Recognition tests). Ten of the 53 subjects showed strong modal preferences: seven preferred auditory, while three preferred visual. Eight of the subjects passed all of the reading tests administered to them at the end of
the second grade. Two subjects failed all reading tests presented.

Ringler, Smith and Cullinan (1971) used the New York University Modality Test to classify learning modality preferences in 128 first grade children. The modalities tested were auditory, visual, kinesthetic, or no preference. After a compilation of preferred modalities and assignments to one of four experimental treatments or to a control group, learning tasks were given to each of the experimental groups. The task consisted of a list of 50 vocabulary words identified as part of the children's speaking vocabulary, but not formally taught in the classroom. The experimental groups received seven and one-half hours of instruction, while the control group received none. All subjects received reading instruction from Bank Street Readers. A criterion test of the 50 list words plus 150 distractor words served as the pre-test and post-test measure of vocabulary development. The results were that (a) the experimental groups made significantly greater gains than did the control group, but did not differ significantly from each other; (b) no significant differences were found among modality preference groups when treatment groups were not considered; and (c) pupils who were taught using their preferred mode did
not make significantly greater gains than those pupils who received instruction through some mode other than their preferred one.

SUMMARY

None of the previously mentioned studies have included the olfactory modality in their research. The Taxonomic Instruction Project (1970) includes a "Sensory Modality Input" as one of its four basic components; however, the olfactory modality is not included in this input system.

Many books and articles have been published by the medical field that relate to olfactory operations in dogs, fish and humans. Education however, almost totally neglects the sense of smell in its written research. Neither Education Research Information Center (ERIC) nor the Education Digest has a descriptor for olfactory or smell. In researching the olfactory modality in education, one could almost assume that smelling is not a component of the learning process if the only information available was what is presently written in educational books and journals.

OLFACTION IN EDUCATION

The research in the area of education related to
olfaction is very sparse. If one can consider a therapeutic-medical model then there is one article that could be applied to education in a very generalized fashion. Wayne and Clinco (1959) discussed olfaction from a psycho-analytic viewpoint. They pointed out the omnipresence of smell in our culture and related this to the fact that we live in a deodorized or reodorized culture. Their article dealt with many Freudian implications, especially related to dream interpretation, but they did reach some conclusions that are supported by other research (Kasatkin, 1969 and Nemanova, 1969). One of their final statements was that:

Olfaction begins with the first breath and cry, fusing the tactile-kinesthetic components to give rise to the snout orientation of the infant during this early vulnerable needful phase, key his later orientation toward olfaction. Throughout our investigation we observed that many of the classic wishes and fears of the orally oriented person were revealed in the olfactory material produced by patients in the process of treatment (p.67).

Stephens (1970) has outlined procedures for assessing the olfactory modality for instructional purposes. Stephens has subjects smell odors from blotting paper for the purpose of odor identification. He then has subjects match pieces of blotting paper which have been soaked in odors. This information would relate to teacher utilization of the sense of smell as a primary
than auditory and visual methods. Edgington (1968) suggest pairing an odor with each vowel sound to provide an additional memory cue for the beginning learner.

Tanner and Zeiler (1975) used aromatic ammonia as punishment to eliminate self-injurious behavior in an autistic woman in an institutional setting. The ammonia served as an aversive stimulus, and the woman stopped slapping herself during experimental conditions.

The only major study in the area of olfactory learning pertaining to education was conducted by Hartman (1974). She posed the question as to whether olfactory stimuli used in conjunction with visual and auditory stimuli would significantly accelerate the acquisition of sight words of beginning kindergarten pupils.

A non-randomized control group pre-test-post-test design was implemented utilizing two experimental groups and a control group. Treatment consisted of teaching selected words to experimental subjects by presenting olfactory, visual, and auditory stimuli to one group, and withholding olfactory stimuli from the second group. Analysis of the data revealed that kindergarten pupils who were taught by either method performed significantly better than those in the control group. Performance of
the subjects in the olfactory group was superior to that of the controls but did not exceed the performance of the non-olfactory experimental subjects.

**SUMMARY**

No conclusions can be drawn from the small amount of educational research in olfaction. Many authors feel the sense of smell is a vital and exciting modality. Scientists have investigated the nose and smelling thoroughly, and continue to find this process mysterious and worthy of research. For educators, the sense of smell is a new frontier and they must look to new uses of the sense of smell if it will help children to learn.
CHAPTER III

METHOD

SUBJECTS

Six inner-city children of an age range of six to seven years who were experiencing learning difficulties served as subjects. All subjects had had physical and psychological examinations and were randomly selected by teachers to participate in this study with parental permission.

The teachers of the study subjects met with the experimenter before the study was begun, and were asked to assign three subjects from their respective classes to the subject population.

The subjects may or may not be mentally retarded, but children who had been assessed as individuals who have met failure in academic situations. Four boys and two girls comprised the subject population. Table 1 provides information relative to each subject
TABLE I

Characteristics of subjects participating in the study

<table>
<thead>
<tr>
<th>SUBJECTS</th>
<th>AGE</th>
<th>I.Q.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject 1</td>
<td>7 years</td>
<td>Stanine 1</td>
</tr>
<tr>
<td>Subject 2</td>
<td>7 years</td>
<td>Stanine 2</td>
</tr>
<tr>
<td>Subject 3</td>
<td>7 years</td>
<td>Stanine 1</td>
</tr>
<tr>
<td>Subject 4</td>
<td>6 years</td>
<td>Stanine 2</td>
</tr>
<tr>
<td>Subject 5</td>
<td>6 years</td>
<td>Stanine 2</td>
</tr>
<tr>
<td>Subject 6</td>
<td>6 years</td>
<td>Stanine 1</td>
</tr>
</tbody>
</table>

* The Cleveland Board of Education reports all I.Q. scores in stanine scores. Stanine 1 refers to I.Q. points from 0-71. Stanine 2 refers to I.Q. points from 72-80. The Stanford Binet Intelligence Test was used for all subjects.
SETTING

The setting utilized for this study was a classroom in a public school building which was not being used for instruction. The room was 40 feet long and 30 feet wide with five large windows and ceilings that were 30 feet high. Fluorescent lighting had been added to the older structure and there were 15 student desks and one teacher's desk in the room. Chalkboards covered two of the room's four walls. A cloakroom made up the third wall. Only a small section of the room was used for the study. This section was a ten by twelve foot area in a corner of the room. A table, five feet long by three feet wide, and five small chairs were placed in the center of this area. The five containers of the odors were placed on the table, each in front of one of the five chairs. The experimenter had a stopwatch, a clipboard, a pencil and forms on which to collect data (Appendix A). The subjects were made familiar with the room and its surroundings on three separate occasions before the study was begun. The subjects were brought from their classrooms to this room by the experimenter who had been introduced to the subjects by their teachers. This room was across the hall from the subjects' classrooms.
ACADEMIC TASKS

Individual academic tasks were determined for each subject with direction from each subject's classroom teacher. The academic tasks assigned had not yet been mastered by the subjects, but subjects did have the prerequisite skills for the tasks. For example, three of the subjects had mastered one-to-one correspondence for the first three numbers, and were being taught the concept of four. These subjects could orally count to four, but had not mastered the one-to-one correspondence. They were being instructed on this task in their classrooms. Two subjects had mastered one-to-one correspondence and were working on mastering the concept of ordinal numbers in relation to one-to-one correspondence. One subject could count orally to 15 and could point to 15 objects, but had only mastered one-to-one correspondence to 12.

For those subjects working on the concept of four in one-to-one correspondence, and for the subject working on one-to-one correspondence with a 15 number concept, the same materials were used. Five different types of objects were used: popsicle sticks, wooden beads, poker chips, plain wooden blocks, and toy plastic animals. The individual objects were changed daily and
were always the same color so as to rule out any color preference variables.

For the two subjects working on ordinal numbers, the materials used were a vertical line of ten identical yellow ducks pasted on a strip of paper 12 inches long and five inches wide. The paper had been laminated so that subjects could mark on it with crayons and then erase their marks. All tasks were in the area of mathematics related to one-to-one correspondence.

**SUBJECT 1**

The task assigned to Subject 1 dealt with the concept of four in a one-to-one relationship. On individual sessions this subject was asked to take four objects, one at a time, from the container and to place them on the table. As the subject placed an object on the table he was to say its corresponding cumulative number. One block was taken out and he sale one, another blocks was taken out and he said two, another, three, and another to make four blocks. The subject was allowed to place as few or as many objects on the table as he wished.

**SUBJECT 2**

The task for Subject 2 dealt with ordinal numbers.
The subject was shown the vertical line of ducks which was placed on the table in front of him. The subject was asked to count the ducks. A crayon was then given to the subject, and he was asked to mark an "x" on the first duck, the second duck, the third duck, and the fourth duck. Directions for marking for each ordinal number were given separately.

**SUBJECT 3**

Subject 3 attempted to master the concept of four in one-to-one correspondence. Procedures for this task were presented in the same way and with the identical objects used for Subject 1.

**SUBJECT 4**

The task for Subject 4 dealt with the identification of ordinal numbers in one-to-one correspondence. Identical procedures and materials which were used for Subject 2 were used for Subject 4. The only modification of the task was that Subject 4's task involved only the identification of the first and second objects.

**SUBJECT 5**

The task for Subject 5 dealt with the one-to-one correspondence for 15 objects. He could orally count to 15, but had only mastered 12 objects in a one-to-one
situation. This subject was given a container of 25 objects at individual sessions. He was asked to take an object out of the container and place it on the table saying its corresponding cumulative number. The same five objects used for Subjects 1, 3, and 6 were used with this subject.

**SUBJECT 6**

The task for Subject 6 was to master the concept of four in one-to-one correspondence. The procedures and materials were identical to those of Subjects 1 and 3.

**PROCEDURES FOR ASSESSMENT OF ODOR PREFERENCE**

The procedure for determining odor preference was identical for each child. Each child was administered the preference test on an individual basis. The five odors used in the preference test were a lilac floral perfume, peppermint extract, lemon extract, onion extract, and water (non-odor).

Tinker Bell, a heavily scented inexpensive perfume, which has a strong sweet odor served as the perfume preference. The peppermint, lemon and onion extracts were obtained from commercially prepared products, the contents of which are generally used for cooking purposes. The water was ordinary tap water daily consumed by the
general population.

The four odors described above have distinct smells and were harmless to the subjects. Water was used as a component for any subject who preferred no odor.

The preference odors were poured into individual four ounce glass containers. One ounce of each odor was put in liquid form into each of the glass containers. The liquid form was used to help diminish any odor variables that may have been present in the air were the odors presented in spray form. To control for the odors decreasing in intensity over time, the liquids were changed on a weekly basis.

The five odors were placed on a table twelve inches apart, with caps on each container and one chair was placed in front of each container. The glass containers were all covered with brown contact paper so as to control for color differentiation. The odors were presented to the subjects for five sessions. At each session the sequence of the containers was changed so as to control for a container placement variable.

Prior to the initial session, the experimenter met informally with each subject for the purpose of establishing rapport. The experimenter shook hands with each subject, introduced himself and the person serving as
the observer, asked the child his name and about himself. Due to the ages of the subjects, questions related to smelling and the part of the face used in smelling were also asked. Each child was then allowed to smell, and then eat a small piece of hard cherry candy.

For each odor preference session, the subject was given the following directions:

On the table you see five jars. There is a chair in front of each jar. You will sit in this chair first (subjects always moved from left to right).

Please listen carefully to me. When I tell you, bend over and smell the jar. (Experimenter uncapped and capped jars). I will touch your shoulder and tell you to stop. (30 seconds per jar was allowed at the initial session; 15 seconds per jar at the following session).

You will smell what is inside each jar. I will tell you when to move to the next chair and to start smelling that jar.

Each subject then smelled the contents of all five jars. Each subject was told he did a good job and was then given the second set of directions:

Now you may smell any of the jars that you wish. You will know when to stop smelling when you hear this sound (ring of a kitchen timer). You may smell any jar for as long as you wish.

Each subject was allowed to continue smelling at random for two minutes. During this time the experimenter measured the amount of time each subject spent smelling each odor. A stop watch fastened to a clipboard was used.
On the clipboard were five sections divided into the five odor classifications, and the experimenter recorded the amount of time spent smelling the contents of each bottle by the individual subjects.

An interobserver reliability check was conducted on two preference sessions for each subject. The observer was a person skilled at counting behavior, and who had a knowledge of graphing procedures. Reliability agreements on all observations were set at 90 percent. The observer had the identical materials of the experimenter, and met with the experimenter after each interobserver session to compare and to compile reliability results.

DATA COLLECTION AND ANALYSIS

DATA COLLECTION: Data were gathered using event recording. The experimenter had as recording instruments a clipboard, pencil and a form (Appendix B) that listed the subject's number, task, the number of trials, and the child's odor preference. At each session the experimenter would record the trial and whether or not the trial had been correctly completed. Responses during sessions were recorded as correct or incorrect task completion. Cumulative data were kept on each subject and then graphed.
INTEROBSERVER AGREEMENT: An observer was present during all baseline and intervention sessions. The observer sat in a chair, behind but to the left of the subject so that the observer could see the responses given by each subject. The observer had five training sessions with the experimenter for this study, but also had prior knowledge and practice in recording behavior.

ANALYSIS: Data were analyzed using a multiple baseline design (Cooper, 1974). This design was chosen because the study dealt with similar but different behaviors of a small group of children. The behaviors were measured at the same time for all subjects before intervention. This would refer to the baseline for all subjects. Intervention was then implemented on only one subject, while the five remaining subjects remained in baseline status. After a behavior change occurred for the first subject, the intervention procedures were implemented for the second subject. The remaining four subjects remained in baseline status. Following a behavior change in the first and second subject, intervention procedures were begun for the third subject. This process was continued for all six subjects.

The multiple baseline analysis serves as an in-
indicator that the intervention applied served as the reason for a change in behavior. It reduces the probability that coincidence was responsible for behavior change. Cooper (1974, p. 137) states that:

A multiple baseline analysis employing two baselines can provide strong implications concerning effectiveness of the intervention technique. However, the greater the number of baselines used in analysis, the greater the confidence that a functional relationship has been demonstrated.

For example, a hypothetical classroom situation could be considered. Three boys have been identified who are out of their seats too many times during math seatwork activities. Baseline is taken concurrently on all three boys for five consecutive sessions. An intervention technique, utilizing a token reward for time spent in-seat is implemented for one boy while baseline is continued for the two other boys. After five more days the first boy has remained in his seat for all of the math period, while the other two boys have continued their out-of-seat behavior. The identical intervention technique is now implemented on the second boy. Baseline conditions are continued for the third boy. After five days of implementation for the second boy, the data show that the second boy has remained in his seat for all of the math period. The token
implementation has served as the reinforcer which changed behavior. The use of the second boy has provided a predictor that coincidence was not the reason for the first boy's behavior change.

Since this was a study comparing individuals to themselves, the utilization of the multiple baseline design was most appropriate. Risley (1969) comments on the use of this design:

Generality of effect across subjects is important of course, but inter-subject generality should be considered apart from the magnitude of the change. In behavior modification research, the usual approach is to work first with a few subjects intensively in order to discover procedures which produce significant changes in their behaviors, and only then to apply those procedures to other subjects. By this process, inter-subject generality is determined not simply as a statement of the range of effects of a specific procedure across subjects, but rather as a description of the procedure required in all subjects (p.11).

This single organism design should allow for replication across subjects. If several replications are produced with significant results in behavior change, then more generalized statements can be made concerning the population studied. Figure A is a hypothetical illustration of the multiple baseline design.

**BASELINE PROCEDURES**

Baseline procedures consisted of individual task
Figure A. Hypothetical Multiple Baseline Design
presentation. Subjects were given their individual tasks and the individual responses were recorded. The experimenter did not relate to the individual subjects the results of the baseline sessions.

**INTERVENTION PROCEDURES**

Intervention procedures consisted of presentation of individually preferred odors to subjects upon successful task completion. Subjects were told before task presentation that they would be allowed to smell the contents of a container if they completed their tasks successfully. Each subject was shown the container before task, but was not allowed to uncap the container or smell the contents. The odors were used as reinforcers for successful task completion. Upon evidence of successful task completion, the experimenter uncapped the container and placed it a few inches from the subject's nose and allowed the subject to smell the odor for ten seconds. A stopwatch was used for timing the duration of smelling. This procedure remained the same during intervention for all subjects during all sessions.
CHAPTER IV

RESULTS OF ODOR PREFERENCE AND ODOR UTILIZATION

The results of this study discussed in this chapter are divided into two parts: 1) results of the odor preference test and 2) results of the utilization of preferred odors as reinforcers for the academic tasks of the subjects.

During task baseline and implementation procedures, an observer was present at all times. Interobserver reliability agreement was calculated at 93 per cent during odor preference tests and remained at 100 per cent during all intervention trials. The observer was present during the odor prefer and odor utilization sessions.

ODOR PREFERENCE

All of the subjects had an odor preference. Some were erratic, but in reviewing the total assessment, all subjects preferred one odor over the others.

SUBJECT 1: The first subject demonstrated a preference for the peppermint odor. Two hundred fifty five seconds were used in the presence of peppermint. Conversely, the next highest duration of time was given to the lemon odor with 71 seconds. Table 2 presents these results. Figure 1 illustrates Subject 1's odor responses over time.
### TABLE 2

Cumulative time (in seconds) spent smelling odors by Subject 1 in five two minute sessions

<table>
<thead>
<tr>
<th>Odor Categories</th>
<th>Cumulative time in seconds per odor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfume</td>
<td>67 seconds</td>
</tr>
<tr>
<td>Peppermint</td>
<td>255 seconds</td>
</tr>
<tr>
<td>Lemon</td>
<td>71 seconds</td>
</tr>
<tr>
<td>Onion</td>
<td>0 seconds</td>
</tr>
<tr>
<td>Water (Non-Odor)</td>
<td>33 seconds</td>
</tr>
</tbody>
</table>
ODOR PREFERENCE TEST
SUBJECT 1

A = PERFUME
B = PEPPERMINT
C = LEMON
D = ONION
E = WATER

Figure 1. Duration of time spent smelling odors in five two-minute sessions for Subject 1.
**SUBJECT 2:** The second subject also showed a preference for peppermint. At the initial session this subject spent the longest duration with peppermint. This subject returned to the container of peppermint and stayed at this container for the remaining sessions for a total of 364 seconds. The subject did not smell peppermint for a full two-minutes during any session, but vocalized that he only wanted to smell this jar. Table 3 presents these results. Figure 2 gives the odor responses over time for Subject 2.

**SUBJECT 3:** The third subject found attention to task very difficult. However, data revealed that this subject preferred the odor of lemon over the others. Two hundred and forty-two seconds were spent smelling the lemon odor, while 55 seconds were spent with water and 50 seconds with perfume. Table 4 presents these results. Figure 3 illustrates the odor responses over time for Subject 3.

**SUBJECT 4:** The fourth subject exhibited an indecisive first and fifth session. The second, third, and fourth sessions revealed a definite preference for the lemon odor. The cumulative time spent with lemon totaled 294 seconds which was far in excess of the 75 seconds spent with the peppermint odor. Table 5 presents these results. Figure 4 illustrates the odor responses over time.
TABLE 3

Cumulative time (in seconds) spent smelling odors by Subject 2 in five two-minute sessions

<table>
<thead>
<tr>
<th>Odor Categories</th>
<th>Cumulative time in seconds per odor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfume</td>
<td>0 seconds</td>
</tr>
<tr>
<td>Peppermint</td>
<td>364 seconds</td>
</tr>
<tr>
<td>Lemon</td>
<td>34 seconds</td>
</tr>
<tr>
<td>Onion</td>
<td>0 seconds</td>
</tr>
<tr>
<td>Water (Non-odor)</td>
<td>30 seconds</td>
</tr>
</tbody>
</table>
ODOR PREFERENCE TEST

SUBJECT 2

A = PERFUME
B = PEPPERMINT
C = LEMON
D = ONION
E = WATER

Figure 2. Duration of time spent smelling odors in five two-minute sessions for Subject 2.
TABLE 4

Cumulative time (in seconds) spent smelling odors by Subject 3 in five two-minute sessions

<table>
<thead>
<tr>
<th>Odor Categories</th>
<th>Cumulative time in seconds per odor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfume</td>
<td>50 seconds</td>
</tr>
<tr>
<td>Peppermint</td>
<td>21 seconds</td>
</tr>
<tr>
<td>Lemon</td>
<td>242 seconds</td>
</tr>
<tr>
<td>Onion</td>
<td>0 seconds</td>
</tr>
<tr>
<td>Water (Non-Odor)</td>
<td>55 seconds</td>
</tr>
</tbody>
</table>
ODOR PREFERENCE TEST
SUBJECT 3

A = PERFUME
B = PEPPERMINT
C = LEMON
D = ONION
E = WATER

Figure 3. Duration of time spent smelling odors in five two-minute sessions for Subject 3.
TABLE 5

Cumulative time (in seconds) spent smelling odors by Subject 4 in five two-minute sessions

<table>
<thead>
<tr>
<th>Odor Categories</th>
<th>Cumulative time in seconds per odor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfume</td>
<td>50 seconds</td>
</tr>
<tr>
<td>Peppermint</td>
<td>75 seconds</td>
</tr>
<tr>
<td>Lemon</td>
<td>294 seconds</td>
</tr>
<tr>
<td>Onion</td>
<td>0 seconds</td>
</tr>
<tr>
<td>Water (Non-Odor)</td>
<td>11 seconds</td>
</tr>
</tbody>
</table>
ODOR PREFERENCE TEST
SUBJECT 4

A = PERFUME
B = PEPPERMINT
C = LEMON
D = ONION
E = WATER

TIME (seconds)

SESSIONS

Figure 4. Duration of time spent smelling odors in five two-minute sessions for Subject 4.
SUBJECT 5: The fifth subject initially chose the lemon odor and stayed with it for all five sessions for a total time of 424 seconds. This subject exhibited the most definite odor preference. Table 6 presents these results. Figure 5 illustrates the odor responses over time for Subject 5.

SUBJECT 6: The sixth subject was the most difficult to assess as she was very active and vocal. The data revealed that the perfume odor with a total time of 255 seconds was the subject's preferred odor. Table 7 presents these results. Figure 6 gives the odor responses over time for Subject 6.

None of the subjects took the full two minutes of time allotted for smelling. Subjects 1, 2, 4 and 5 used 71 per cent of the total time. Subject 3 used 61 per cent and Subject 6 used 59.5 per cent of the total time. Some were distracted by noises outside of the room, and some sat doing nothing for short periods. However, the data collected provided sufficient information to permit the experimenter to assign each child an odor preference. That is, they each spent more time smelling odors than not emitting the response. Table 8 presents the cumulative time spent smelling
TABLE 6

Cumulative time (in seconds) spent smelling odors by Subject 5 in five two-minute sessions

<table>
<thead>
<tr>
<th>Odor Categories</th>
<th>Cumulative time in seconds per odor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfume</td>
<td>0 seconds</td>
</tr>
<tr>
<td>Peppermint</td>
<td>0 seconds</td>
</tr>
<tr>
<td>Lemon</td>
<td>424 seconds</td>
</tr>
<tr>
<td>Onion</td>
<td>0 seconds</td>
</tr>
<tr>
<td>Water (Non-Odor)</td>
<td>0 seconds</td>
</tr>
</tbody>
</table>
Figure 5. Duration of time spent smelling odors in five two-minute sessions for Subject 5.
TABLE 7

Cumulative time (in seconds) spent smelling odors by Subject 6 in five two-minute sessions

<table>
<thead>
<tr>
<th>Odor Categories</th>
<th>Cumulative time in seconds per odor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfume</td>
<td>255 seconds</td>
</tr>
<tr>
<td>Peppermint</td>
<td>57 seconds</td>
</tr>
<tr>
<td>Lemon</td>
<td>22 seconds</td>
</tr>
<tr>
<td>Onion</td>
<td>11 seconds</td>
</tr>
<tr>
<td>Water (Non-Odor)</td>
<td>12 seconds</td>
</tr>
</tbody>
</table>
ODOR PREFERENCE TEST
SUBJECT 6

A = PERFUME  
B = PEPPERMINT  
C = LEMON  
D = ONION  
E = WATER

Figure 6. Duration of time spent smelling odors in five two-minute sessions for Subject 6.
**TABLE 8**

Cumulative time (in seconds) spent smelling all odors by all subjects in five two-minute sessions.

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Odor Categories</th>
<th>Cumulative time in seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Perfume</td>
<td>Peppermint</td>
</tr>
<tr>
<td>1</td>
<td>67</td>
<td>255</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>364</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>50</td>
<td>75</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>255</td>
<td>57</td>
</tr>
<tr>
<td>TOTAL</td>
<td>422</td>
<td>772</td>
</tr>
</tbody>
</table>
for the five subjects with the five odors. The data revealed that subjects smelled the lemon odor for the longest time, with a cumulative total of 1,087 seconds. Peppermint was the second preferred odor with a total of 772 seconds. The onion odor was smelled the least with a total of only 11 seconds. Three of the four odors were used as reinforcers, with lemon utilized for three subjects, peppermint for two subjects, and perfume for one subject.

**ODOR PREFERENCE UTILIZATION**

Figures 7 and 8 present the data collected in cumulative form. During baseline and intervention, the data was reported in the number of correct trials in relation to the total number of trials.

**SUBJECT 1**

Subject 1's task dealt with the concept of four. Five sessions were conducted with this subject, and at each trial he placed either seven or eight objects on the table. His counting was erratic during all of the sessions. One, two and three were always correct in sequence, but the following numbers were given in a variety of ways.

On the sixth session, the subject was told that if
Figure 7. Baseline and Intervention data for Subjects 1, 2, and 3 for the number of correct trials of the number of trials during academic tasks.
Figure 8. Baseline and Intervention data for Subjects 4, 5, and 6 for the number of correct trials of the number of trials during academic tasks.
he put four objects on the table he would be allowed to smell the odor he preferred, peppermint. Subject 1 put four objects on the table and was given the odor reinforcement for ten seconds. On the following four sessions, the subject was given identical directions. On each of the four sessions the subject placed four objects on the table and told the examiner that there were four and only four objects on the table. For this subject the peppermint odor served as a reinforcer for an academic task.

**SUBJECT 2:**

Subject 2's task dealt with ordinal numbers. The material was presented for ten consecutive sessions and the subject did not master the task. At the eleventh session the subject was told that if he marked an "x" on the appropriate ducks he could smell the contents of the container (peppermint). Upon presentation of the material the subject mastered the task on the eleventh trial and on the following four sessions. The peppermint odor served as a reinforcement for his academic work.

**SUBJECT 3:**

Subject 3's task dealt with the concept of four. After 15 sessions the task had been mastered only once
during the tenth session, but was not mastered again on the following five trials.

The lemon odor was the subject's preferred odor. The subject was told that she could smell the odor if she counted out four objects. On the sixteenth session the subject did master the task with 100 per cent accuracy and did so on each subsequent day of testing. The preferred odor of lemon served as a reinforcer for this academic task.

**SUBJECT 4**

Subject 4's task dealt with ordinal numbers. After 20 sessions of examiner presentation, the subject had not mastered the task. On the 21st session the subject was told if he could mark the first duck he would be allowed to smell the container. (His odor preference was lemon). The same directions were given for marking the second duck.

On the first session of implementation, the subject marked the first duck and was reinforced with the odor, however, he did not mark the second duck correctly and was not reinforced. On the following four sessions he mastered the task at each presentation and was reinforced by the lemon odor. Again, the odor preferred served as a reinforcer for academic task mastery.
SUBJECT 5 and 6:

Subjects 5 and 6 served as the non-treated controls for this study. After 25 sessions neither subject had mastered the task presented. Neither subject had had any odor reinforcement. However, in order to see if their behavior could be changed via odor reinforcement, the study was continued to include these two subjects.

SUBJECT 5:

After 25 trials, Subject 5 was consistently confusing the sequence for 13, 14, and 15. For implementation, the examiner decided to pair the 13, 14 and 15 numbers with his preferred odor, lemon. He could say 12, 13, 14, 15 in correct sequence, but became confused as he was counting objects. The experimenter had the subject count to 12 and then paired the number 13 with the lemon odor and had the child say and smell simultaneously. The identical procedures was applied to the numbers 14 and 15. On the first trial only 13 was mastered, but on the succeeding four sessions, the subject mastered the task with the aid of the lemon odor reinforcement.

SUBJECT 6:

Subject 6's task dealt with the concept of four. After 30 sessions she had not mastered her task. Perfume was her preferred odor and this was to be presented
to her upon task mastery. In the first two sessions of implementation the subject mastered the task, but on the following three sessions the subject failed to master the task. The odor reinforcement initially elicited a positive response, but the odor did not sustain its reinforcement power over time.

**SUMMARY**

With the introduction of the odor reinforcers, the number of correct responses increased to mastery of task for five of the six subjects. There was a definite change in the behavior of all subjects during implementation when compared to each subject's performance during baseline conditions.
DISCUSSION

The purposes of this study were to first determine if your subjects would have a definite odor preference, and then to see if this preference would serve as a reinforcer for academic task completion. This study sought only to answer the research questions. There has been no previous experimental work with children done in this area that relates directly to odor preferences. Therefore, this study did not support or refute any previous research.

The results show a definite change in behavior for five of the six subjects. Although no statistical analysis was applied to this data, there was an immediate change in the response patterns of all subjects when odor reinforcement was initiated. Furthermore, extended baseline trials showed that a favorable response was unlikely to occur until reinforcement was initiated. These results demonstrate a clear functional relationship between the independent variable (odor reinforcement) and the dependent variable (math concepts).
The children responded very positively to using odors, although they all said that they had never used smells in school. They were excited about the odor preference trials and went quickly to their seats and proceeded with the test with little encouragement. Each subject was quick to avoid the onion odor. If one were looking for an aversive stimulus for any of these six children, the onion odor would certainly serve that purpose.

During the academic task reinforcement trials, the five subjects responded immediately to the idea of smelling the contents of the jar. The subjects must have good delayed recall for the olfactory modality because they remembered that an odor was in the jar and they were anxious to smell the odor. The positive academic results also reveal that the odors provided strong reinforcement for successful task completion.

LIMITATIONS

The first limitation was the sample size. Using only six subjects does not permit generalization of results to other children or groups of children.

The second limitation was that only four odors (plus water) were included as preference items. The inclusion
of many types of odors would allow subjects a greater variety of choices. However, the great variety of odors would continually present the problems of further classifications for the appropriate categorical choices.

**IMPLICATIONS FOR FURTHER RESEARCH**

As the results of this study were positive, the uses of olfaction in teaching need to be more thoroughly explored. Educators do not know if the sense of smell will be a powerful learning channel because the research in this area has not really even begun.

The research should be concentrated with pre-school and primary age children so as to help them to better develop their odor sense for things other than pleasure and danger. Physical science research has shown that one can distinguish odors quickly, so that information should be applied directly to the classroom.

Suggestions for further research might include:

a) pairing a specific odor with a specific symbol (number or letter) and teaching them simultaneously, then withdrawing the odor.

b) word and letter reversals could be differentiated with a pleasant odor assigned to the correct position and an aversive odor assigned to the reversal.

c) develop a time out area, (punishment) then construct an odor area in a classroom where students could go as a reinforcer for appropriate
social behavior. Compare the results of behavior before and after inclusion of odor area.

d) replicate this study with a blind or deaf-blind population.

SUMMARY

With the use of a determined odor preference as a reinforcer, a definite change in behavior occurred in five of the six subjects in this study. The subjects mastered skills with the aid of their preferred odor that they were unable to master before the introduction of the contingent odor preference.

Almost all of the research efforts of educators in modality areas have centered and continue to center on visual and auditory learning channels. Olfactory modality research has been very sparse, and this was one of the reasons that this study was conducted. The specific purpose was to answer questions pertaining to individual odor preferences, and to the use of these odor preferences as reinforcers for academic tasks. Data collected resulted in positive answers to both questions. What is more important is that children found a new channel for learning and that they did learn new concepts.

If the introduction of olfactory teaching can help to better facilitate even one child's learning, then
research in this area should be continued. Many children are failing in schools today. The failure causes are too numerous and too individualized to even discuss. However, one reason for the individual failure may be that the visual, auditory and haptic modes of learning are not sufficient, and that a fourth mode, olfactory must be included as a channel for receiving information and reinforcement so that failure can be diminished, if not extinguished.
REFERENCES


Keller, H. "Sense and Sensibility." The Century Magazine. 75. 1908, 23.


APPENDIX A

RECORDING SHEET FOR ODOR PREFERENCE
# ODOR PREFERENCE TEST

<table>
<thead>
<tr>
<th>Subject</th>
<th>Perfume</th>
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<th>Onion</th>
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Session #1 Preference
Session #2 Preference
Session #3 Preference
Session #4 Preference
Session #5 Preference
Odor Preferred
APPENDIX B

RECORDING SHEET FOR ACADEMIC RESPONSES
## Baseline and Implementation Chart

**Subject:**

**Task:**

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