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EFFECTS OF POSITIVE REINFORCEMENT ON AN ASSESSMENT MEASURE OF VISUAL PERCEPTION BEHAVIOR

by

Robert Gray Ferree, III

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Dissertation Adviser

APPROVAL PAGE

This dissertation has been approved by the following committee of the Faculty of the Graduate School at The University of North Carolina at Greensboro.

Dissertation Adviser P. Scott Lawrence

Committee Members W. Larry Osborne

Mailee K. Scott

Marian Franklin

Jon Guy Stowe

October 21, 1975
Date of Acceptance by Committee

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The purpose of this study was threefold: (a) to investigate the effects of presenting various reinforcement procedures contingent on correct responses to a test of visual perception, (b) to determine if there is a difference in performance between boys and girls as a possible differential effect of a male examiner, and (c) to determine if a difference exists in responsiveness to the various types of reinforcers as a function of social class.

The subjects were 80 children, ranging in age from 59 to 75 months and equally divided by sex, who attended regular kindergarten classes. The subjects were dichotomized into middle- and lower-socio-economic classes by utilizing the Hollingshead Two-Factor Index of Social Position. The dependent measure was performance on the Frostig Developmental Test of Visual Perception (DTVP), which consists of five separate subtests measuring different perceptual skills. Groups of 20 randomly selected subjects were randomly assigned to one of four treatment groups: (a) no reinforcement (NR)--subjects were administered the DTVP with no reinforcement presented by the examiner; (b) social reinforcement (SR)--subjects were reinforced by verbal approval statements, e.g., "Good," "Okay," etc., upon making correct DTVP responses; (c) material reinforcement (MR)--subjects were reinforced with "penny" candy upon making correct DTVP responses; and (d) combined social and material reinforcement (SMR)--subjects received both types of reinforcement under the same conditions of the SR and MR groups. Reliability of dispensing treatment and of scoring the dependent measure was assessed by independent judges.

After treatment, the DTVP Subtest, total Scaled, Perceptual Quotient, and variability scores were subjected to a three-way factorial analysis of variance (treatments X social class X sex). Significant differences revealed by the analyses were further analyzed by the Newman-Keuls procedure for post-hoc mean comparisons. Magnitude of significant effects was tested by the Omega Square ($\underline{W}^2$) method of correlation. Lastly, in order to assess the effects of the treatment conditions on the reliability of the DTVP, split-half reliability coefficients were computed for each treatment condition.

Results revealed significant main treatment effects for DTVP Subtests III, IV, V and for total test performance. There were no social class or sex effects and only one significant treatment X sex interaction effect for Subtest III. Of the significant main treatment effects, from 6% to 25% of the variance of the DTVP scores was accounted for by the different modes of reinforcement presentation. The Newman-Keuls test demonstrated that social reinforcement produced significantly higher DTVP scores on the subtests and total test. Also, the SMR condition produced significantly higher Perceptual Quotient scores over the NR treatment. Furthermore, results demonstrated significant effects for treatment and social class on the analysis of variance of variability scores. Higher DTVP score variability was found for social reinforcement presentation and for the lower-socioeconomic group of subjects. Although statistically insignificant, higher split-half reliability coefficients were obtained under the reinforcement conditions as compared to the NR treatment.

In conclusion, results indicated the significant superiority of social reinforcement in producing higher DTVP scores of kindergarten-age children. Also, subjects in the social reinforcement and lower-class groups had scores with significantly higher variability. It was also demonstrated that the presentation of reinforcement in general was responsible for higher DTVP split-half reliability coefficients. However, it was determined that the use of a male examiner produced no significant differences in DTVP scores of boys or girls and that social class was not a significant variable in influencing the subject's degree of responsiveness to the various types of reinforcers.

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TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Interest in visual perception in young children and its relationship to later academic success and to learning disorders has led to the development of several visual perception tests and training programs. Tests of visual perception ability have gained acceptance and usage as diagnostic indicators of learning disabled children and as instruments to assess specific perceptual deficiencies in order to establish a base for remediation efforts. Of the several diagnostic signs of learning disorders, difficulty in visual perception ability is regarded as a significant indicator in the assessment of such disorders (Cruikshank, 1971; Koppitz, 1963).

Piaget (1954) in his theory of cognitive development identified a perceptual (preoperational) stage of development occurring from ages 4 through 7 years. He theorized that the young child attempts to understand his world directly without using thought processes to evaluate the reality of what he sees. Therefore, the child experiences the world as "here and now." For the child, what he sees, hears, feels, and tastes are true reflections of the world. The child learns by manipulation during the perceptual phase. He learns to perceive size, shape, color, and direction as a result of his touching and feeling objects in his environment (Frostig, 1967).

It follows that the perceptual phase is important in the learning process. Accurate visual perception is necessary in order to evaluate correctly the events taking place in the environment and to be in a position to maintain or alter behavior accordingly. Perceptual disorders by reciprocation can disturb all levels of experience; therefore, lack of perceptual skills has implications in learning disorders. More specifically, perceptual deficits have been found to be related to poor classroom adjustment (Maslow, Frostig, Lefever, & Whittlesey, 1964; McBeath, 1966) and poor reading achievement (Benger, 1968; Bryan, 1964; Ferguson, 1967; Goins, 1958; Maslow et al., 1964; Sprague, 1963). Therefore, the identification and remediation of children with perceptual impairments is indicated.

Marianne Frostig and her associates have developed an assessment instrument and a remediation program for identifying and treating perceptual difficulties. Both the test and remediation program have generated conflicting opinions with regard to their general usefulness (e.g., Allen, Dickman, & Haupt, 1966; Alley, 1968; Beck & Talkington, 1970; Forgone, 1966; Jacobs, 1968; Talkington, 1968; Wiederholt & Hammill, 1971). Another area which also is lacking in empirical knowledge is information concerning the influence of examiner-examinee and teacher-student relationships on perceptual performance of both the assessment instrument and remediation program. More specifically, the effects of giving feedback by dispensing reinforcement during the use of the Frostig materials need clarification in terms of increasing perceptual performance and influencing the reliability of the test instrument.

The use of liberal social reinforcement is advocated by Frostig in the instructions for administering the Frostig Developmental Test of

Visual Perception (Frostig, Lefever, & Whittlesey, 1964). The instructions suggest that praise and encouragement be given frequently but no information is offered concerning the effects on performance of such reinforcing conditions. Also, there are no instructions provided with respect to giving praise for correct responses or for general effort.

Moreover, in the manual accompanying the Frostig remediation program (Frostig & Horne, 1973) no reference is made to the systematic application of reinforcement to responses on the program worksheets. The only mention of reinforcement made by Frostig is in reference to maintaining a "positive tone" throughout the administration of the program. There were no reports found in the literature investigating or suggesting the use of behavioral techniques as an aid to increase perceptual learning on the Frostig remediation program. However, in a well-controlled investigation by Wiederholt and Hammill (1971), the efficacy of the Frostig remediation materials in teaching perceptual skills was related to the number of worksheets completed by the student.

There is evidence in the literature, albeit not definitive, suggesting that scores on standardized tests as well as performance on perceptual measures are influenced by reinforcing conditions and other variables, e.g., examiner-examinee relationship, socioeconomic status of the examinee, and sex of the examinee. For example, Witmer, Bornstein, and Dunham (1971) found that social reinforcement was effective in increasing total test performance on four WISC subtests. Bergan, McManis, and Melchert (1971) concluded that reinforcement was a significant factor in increasing performance on the WISC Block Design subtest, a perceptual task. In addition, sex differences in the effects of material versus social reinforcement presentation were found on Block Design subtest performance. Other studies (Higgins & Archer, 1968; Swingle & Coady, 1969; Terrell, Durkin, & Wiesley, 1959) have suggested differences in responsiveness to various types of reinforcement as a function of social class. These studies have found that middle-class subjects tend to be more responsive to nonmaterial incentives while lower-class subjects tend to be more responsive to material incentives; therefore, cultural differences are significant factors in the degree of responsiveness to reinforcement presentation on various assessment instruments.

In summary, the use of praise, encouragement and other social reinforcers is advocated when administering the Frostig materials; however, the effects on performance of such reinforcement presentation has not been investigated. Inasmuch as certain attribute variables have been found to be related to reinforcer effectiveness, the effects of these variables deserve clarification. The haphazard use of reinforcement may have differential effects on the performance of various types of subjects on the Frostig materials. This factor could possibly affect the reliability of the assessment instrument. In order to determine the answer to these and other problems, an investigation to assess the effects of reinforcement on the Frostig materials is warranted.

Statement of Problem

The purpose of this study was to investigate the effects of three types of reinforcement presentation--social, material, and social plus material--on the performance of five perceptual tasks which are assessed by the Frostig Developmental Test of Visual Perception (DTVP). Reinforcement was presented contingent on correct perceptual response for two different socioeconomic levels of kindergarten-age subjects.

Answers to several questions were sought. The primary question attempted to discover if the presentation of various positive reinforcement procedures affects the performance of kindergarten children on the DTVP. More specifically, does contingent positive reinforcement increase DTVP scores?

Secondly, because of a possible function of a differential reinforcing effect exerted by the male examiner used exclusively in this study, does a difference exist in performance between kindergarten girls and boys on the DTVP?

Lastly, is material reinforcement more important for lower-class youngsters in influencing performance on the DTVP? And, is social reinforcement more important for middle-class youngsters in influencing performance on the DTVP?

Hypotheses

1. There will be a significant main effect for kind of reinforcement presentation on examinee performance on the five DTVP subtests and for total test performance.

2. There will be a significant main effect for sex of examinee on examinee performance on the five DTVP subtests and for total test performance.

3. For middle-class subjects social reinforcement and combined social and material reinforcement will be significantly superior over material reinforcement and no reinforcement in increasing performance on the five DTVP subtests and the total test.

4. For lower-class subjects material reinforcement and combined social and material reinforcement will be significantly superior over social reinforcement and no reinforcement in increasing performance on the five DTVP subtests and the total test.

Significance of the Problem

The influence of the examiner on the examinee's performance on intelligence tests has been established by several studies (Edlund, 1972; Feldman & Sullivan, 1971; Hurlock, 1924, 1925; Witmer et al., 1971). There is some evidence that the examiner can influence performance via presenting positive reinforcement (praise and material rewards) on some perceptual tasks (Bergan et al., 1971; Rigby & Rigby, 1956; Willcutt & Kennedy, 1963). The present study attempts to extend findings of earlier studies and to determine effects of examiner reinforcement on other types of operationally defined perceptual tasks. If an influence can be established, it may possibly suggest that reinforcement on the DTVP should be presented on a systematic basis in order to insure more standardized conditions of test administration and to increase reliability of results.

If the administration of positive reinforcement is found to increase DTVP performance, it would tend to suggest that positive reinforcement can increase acquisition of perceptual skills using Frostig remediation worksheets, as the worksheets are structured in conjunction with the DTVP.

A final significant point of this study centers on the influence of extrinsic reinforcement on the diagnostic usefulness of the DTVP. Because perceptual deficiencies have been linked to organic dysfunction and lags in development, the finding that perceptual skills may be influenced by reinforcement may have implications for perceptual performance as a diagnostic indicator. If it can be demonstrated that DTVP performance may be changed substantially by the use of encouragement and other incentives during the administration of the test, then the use of reinforcement or other types of extrinsic incentives could make the use of the test questionable as a diagnostic indicator of a specific neurological impairment.

Assumptions

It was assumed that subject variables of race and socioeconomic status are factors which may influence performance on the dependent measure. Inasmuch as the standardization sample for the DTVP was limited to white, middle-class and some lower-class children, it would be inaccurate to compare children from other racial origins and, to some extent, other socioeconomic backgrounds to the norm group. This factor was considered in regard to selection of subjects for the study. That is, subjects were limited to Caucasians and control was exerted over socioeconomic status by dichotomizing subjects into middle- and lower-class groups.

It was assumed that verbal praise has sufficient positive valence in order to function as an incentive. However, such an assumption was not presumed in regard to the reinforcing value of material rewards. Therefore, subjects were able to select from a group of material incentives in order to increase the probability that the reward has positive valence for the subject.

Limitations

The study was limited to Davidson County, North Carolina, insofar as the sample of subjects was selected.

The study was limited to children of kindergarten age (59 to 75 months) who attend public kindergarten in the above-named county.

Restrictions on sampling were that all subjects be Caucasian from middle- or lower-class backgrounds and attend regular kindergarten classes.

Therefore, any conclusions drawn from the study cannot be generalized beyond 5-year-old, white, middle- and lower-class children who attend regular kindergarten classes in Davidson County, North Carolina.

Definition of Terms

1. Perception is the "ability to recognize stimuli and to differentiate among them [stimuli]. This ability includes not only the reception of sensory impressions from the outside world and from one's own body, but the capacity to interpret and identify the sensory impressions by correlating them with previous experiences. This recognition and integration of stimuli is a process that occurs in the brain, not in the receiving organ, such as the ear or the eye" (Frostig & Horne, 1973, p. 9).

2. Visual-motor perception involves both visual perception as well as motoric expression, i.e., the reproduction of that which has been seen or perceived by the individual.

3. Eye-motor coordination involves the "drawing of continuous straight, curved, or angled lines between boundaries of various width, or from point to point without guide lines" (Frostig, Lefever, & Whittlesey, 1966, p. 5).

4. Figure-ground perception involves "shifts in perception of figures against increasingly complex grounds. Intersecting and 'hidden' geometric forms are used" (Frostig et al., 1966, p. 5).

5. Constancy of shape perception involves "the recognition of certain geometric figures presented in a variety of sizes, shadings, textures, and positions in space, and their discrimination from similar geometric figures. Circles, squares, rectangles, ellipses, and parallelograms are used" (Frostig et al., 1966, p. 5).

6. Position in space perception involves "the analysis of reversals and rotations of figures presented in series. Schematic drawings representing common objects are used" (Frostig et al., 1966, p. 5).

7. Spatial relationship perception involves "the analysis of simple forms and patterns. These consist of lines of various lengths and angles which the child is required to copy, using dots as guide points" (Frostig et al., 1966, p. 5).

8. Perceptual age "is defined in terms of the performance of the average child in the corresponding age group for each subtest [on the Frostig DTVP]" (Frostig et al., 1966, p. 30).

9. Scaled scores on the DTVP are "perceptual ages divided by chronological ages [of the examinee] and multiplied by 10, adjusted to the nearest whole number: PA/CA x 10 = Scaled Score" (Frostig et al., 1966, p. 30).

10. Perceptual quotient is a "deviation score obtained from the sum of the subtest scaled scores after correction for age variation. Unlike the Scaled scores, however, it is not a ratio; it has been defined in terms of constant percentiles for each age group, with a median of 100,

upper and lower quartiles of 110 and 90 respectively, and other percentile ranks consistent with IQ values of the Wechsler Intelligence Scale for Children (WISC)" (Frostig et al., 1966, p. 30).

11. Reinforcement is a procedure that has occurred when the contingent use of a stimulus results in an increase or maintenance of a dependent behavior.

12. Reinforcer is a stimulus, the contingent use of which results in the increase or maintenance of a dependent behavior.

13. Social reinforcer is a conditioned reinforcing stimulus mediated by another individual within a social context, e.g., giving verbal praise.

CHAPTER II

REVIEW OF RELATED LITERATURE

A search of the literature was conducted in the following areas: (a) the nature of reinforcement, (b) the application of positive reinforcement to responses on standardized tests, and (c) the relationship of reinforcement to the field of perception in general. A summary of information regarding the reliability and validity of the dependent measure and other classification measures is included at the end of the literature review.

The Nature of Reinforcement

An attempt to produce an exhaustive review of operant application to behavior change would be practically impossible. As Krasner (1971) states, the operant literature has grown abundantly in the past several years with studies numbering in the thousands. Therefore, the purpose of this section is to review some of the more basic applications of operant conditioning and, more specifically, of positive reinforcement to behavior change.

First of all, the operant paradigm necessitates definition. Skinner (1938) distinguishes between operant and respondent conditioning. In respondent conditioning the stimulus elicits and precedes a response while in operant conditioning the stimulus follows the response. Krasner (1971) adds that "operant behavior implies an active individual operating on his environment and behavior is determined by its consequences" (p. 613).

A procedure which has been subjected to much investigation as a behavior consequence is reinforcement. Essentially, reinforcement is a procedure which can be utilized in order to increase or to maintain a certain behavior. If a behavior is not maintained or decreases in its frequency, then the consequences of the behavior are not reinforcing. Negative and positive reinforcement procedures have been identified, but this review concerns only the procedure of positive reinforcement as it operates as a stimulus to increase or to maintain a behavior response.

A basic type of reinforcer is labeled as a primary reinforcer, i.e., a stimulus that maintains or perpetuates life. Some examples of primary reinforcers are food, water, sex, and warmth. Many behaviors have been subjected to the influence of primary reinforcement. For instance, Siqueland and Lipsett (1966) demonstrated that head-turning behavior of infants can be controlled by using food as a primary reinforcer. They were successful in teaching an infant to turn his mouth away from the touch of a hand by delivering food as a consequence of turning opposite from the hand touch.

Primary reinforcement has been used to teach language, physical and social skills to severely disturbed children. For example, Wolf, Risley, and Mees (1964) used bits of food to reinforce speech acquisition and wearing-eye-glasses behavior in an autistic child. Myerson, Kerr, and Michael (1967) used food to teach walking to a retarded 9-year-old child while Risley (1968) used candy to reinforce imitative behavior of pre-school children. More complex social behaviors have also proven to be amenable to primary reinforcement as evidenced by Wheeler and Sulzer (1970) using food to teach syntactical sentence structure.

The effectiveness of using primary reinforcement is sometimes dependent on the deprivation state of the subject (Sulzer & Mayer, 1972). If the individual has been deprived of a certain primary reinforcer for some length of time, its potency increases. Therefore, an individual who is hungry may increase his performance if that performance is contingent upon an edible reinforcer.

Another type of reinforcer which is purported to be as effective as primary reinforcement is conditioned reinforcement. A conditioned reinforcer is "a stimulus, an object, or an event that initially was neutral but, through frequent pairings with primary or strong conditioned reinforcers, has assumed reinforcing properties" (Sulzer & Mayer, 1972, p. 26). Conditioned reinforcers are by nature individually determined, i.e., their strength and effectiveness vary from person to person according to past experience or reinforcement history. When stimuli such as smiles, praise, attention, affection, etc. begin to maintain and/or to increase behavior without the presence of primary reinforcement, then they have achieved the status of conditioned reinforcers (Sulzer & Mayer, 1972).

The concept of a conditioned reinforcer can be carried one step further. When conditioned reinforcers develop the property to maintain or strengthen a wide variety of behavior, they can be labeled as generalized reinforcers. Generalized reinforcers tend to have certain advantages over other types of reinforcers. For example, fluctuating conditions, viz., deprivation or satiation, only minimally affect generalized reinforcers. Also, in the normal population such factors as attention, money, and praise tend to maintain their reinforcing properties regardless of deprivation or satiation states; therefore, generalized reinforcers tend to function effectively under many circumstances (Sulzer & Mayer, 1972).

Much research has been conducted and reported within the last several years in the area of changing school-related behaviors by means of applying reinforcement. Social reinforcement, i.e., a conditioned reinforcer, has been a widely investigated independent variable for changing school-related behaviors. Operationally defined, social reinforcers are giving attention, e.g., looking at, nodding, answering another person, smiling, and making positive verbal statements. For example, Johnston, Kelley, Harris, and Wolf (1966) used social reinforcement to modify play-ground behavior in the school setting. These investigators applied social reinforcement contingently to induce a 3-year-old boy to engage in vigorous play activities on a climbing apparatus. Observational records showed that the boy seldom played with other children during the school play period. Adult social reinforcement was applied contingently upon the use of the playground equipment. Reinforcement consisted of standing within 10 feet of the boy, watching him, speaking to him, touching him, and taking equipment to him. Social reinforcement was withdrawn when the child was not touching the equipment. The criterion for reinforcement was narrowed gradually until reinforcement was contingent upon touching the climbing equipment. Climbing increased from less than 1% of playtime to over 60% of the time. A reversal of contingencies demonstrated that social reinforcement was the controlling factor in increasing the climbing behavior. The child's verbal behavior and social interactions with other children increased as well. The writers hypothesized that these activities were reinforced when they occurred simultaneously with the reinforced behavior.

Other investigators have applied social reinforcement in an attempt to change a variety of behaviors. For example, the modification of student-attending behavior has been reported by several authors (Allen, Henke, Harris, Baer, & Reynolds, 1967; Kennedy & Thompson, 1967). Kennedy and Thompson (1967) used verbal praise and smiles to increase eye contact in a counseling situation. Social reinforcement has been used to increase self-esteem and positive self-reference statements as assessed by a paper and pencil test (Ludwig & Maehr, 1967). They determined that giving approving kinds of statements contingent upon performance in a physical education class changed self-reference statements in a positive direction.

In the clinical setting Lovaas and his associates (Lovaas, 1961; Lovaas, Freitag, Gold, & Kassorla, 1965; Lovaas, Freitag, Nelson & Wahlen, 1967) have used social reinforcement to modify deviant behaviors of severely disturbed autistic children. Basically, Lovaas and his group have centered their research on developing appropriate social reinforcers for children who have been nonresponsive to any form of human interaction. One report (Lovaas et al., 1967) developed social reinforcers for maintaining certain appropriate behaviors in two schizophrenic children. The experiment involved the establishment of a social stimulus (a pat on the back and the word good) as a cue for the delivery of food. In order to test the effectiveness of the social stimulus as a reinforcer, social reinforcement was delivered contingent on a bar pressing response. The results demonstrated that the social stimulus became an effective reinforcer for the children. As long as the social stimulus was maintained as a discriminative stimulus for food, its effectiveness as a reinforcer was maintained.

The use of token reinforcement, a special case of conditioned reinforcement, is another widely used reinforcement procedure in both educational and clinic settings. "A token is an object that can be exchanged at a later time for another reinforcing item or activity" (Sulzer & Mayer, 1972, p. 32). Krasner (1971) identified three important aspects in establishing a token reinforcement program. First of all, target behaviors must be determined. Secondly, a medium of exchange must be established, i.e., "an object, the token, that 'stands for' something else, a back-up reinforcer" (p. 636). Thirdly, the back-up reinforcer must have value for the individual involved.

According to Krasner (1971), Staats, in 1965, was one of the first investigators to use token reinforcement as a replacement for primary reinforcement. The purpose of his procedure involved teaching reading discrimination to children. Correct target behavior responses were reinforced by giving marbles, later to be exchanged for other reinforcers.

Ayllon and his associates (Ayllon, 1963; Ayllon & Azrin, 1965; Ayllon & Houghton, 1962, 1964; Ayllon & Michael, 1959) report the effective use of token reinforcement for modifying behavior of patients in mental hospitals. An example of the use of token reinforcement on a psychiatric ward is offered by Ayllon and Azrin (1965). They sought to initiate, maintain, and increase such hospital-related behaviors as cleaning floors, washing dishes, sorting laundry, and self-grooming. In selecting back-up reinforcers, they applied Premack's principle that any high frequency behavior can serve as a reinforcer; therefore, no a priori decisions were made regarding what would be reinforcing to the patients. The patients were observed and back-up reinforcers became those activities which had high levels of occurrence. Such activities as being able to select meal partners, opportunity to consult with psychiatrists, television privileges, candy, cigarettes, etc. were the back-up reinforcers. A series of six experiments were carried out with the results demonstrating that reinforcement was effective in maintaining performance of the target behaviors. Using an ABA design, each experiment resulted in a decrease in performance when token reinforcement was discontinued. However, when reinforcement was reinstated, desired performance increased and was maintained.

In summary, the operant literature is abundant with studies illustrating the effectiveness of positive reinforcement as a method of behavior change. Three types of reinforcement--primary, conditioned, and generalized--were described. Conditioned and generalized reinforcement were further subdivided into social and token reinforcement. All of these types and levels of reinforcement were described as being effective in increasing, maintaining, and otherwise modifying a wide variety of behaviors in both educational and clinical settings.

Application of Reinforcement to Standardized Tests

Since the origin of individually administered tests (intelligence, personality, perception tests, etc.) the question of the effect of examiner-examinee interaction upon examinee performance has been raised. The problem of the influence of different external factors on test administration has been studied, but varying results have been produced by this research.

There seems to be general agreement in the literature that optimal performance is the goal of standardized tests, group and individual (Klugman, 1944; Terman & Merrill, 1937; and Wechsler, 1959). It is possible to control some testing variables, e.g., physical conditions and administrative variables; however, the effect of social relationship between examiner and subject, i.e., the positive and negative feedback, is difficult to describe, to control, and to assess as it relates to achieving optimal test performance.

In 1916 Terman suggested that the delivery of praise to the examinee was a factor in influencing rapport. He further stated that the child should be kept interested, confident, and working at an optimal level of effort. In a later publication Terman and Merrill (1937) recommended that examiners enlist the subject's best efforts in order to insure a greater degree of optimal performance and valid results. In order to obtain high effort, rapport must be established and maintained; therefore, the generous and frequent use of praise was advocated.

In his Manual for the Wechsler Intelligence Scale for Children-Revised (WISC-R), Wechsler (1974) continues to be less clear and less specific than Terman and Merrill in his treatment of examiner-examinee performance interaction. Although Wechsler shares the views of Terman and Merrill that the test should elicit scores reflecting optimal performance, he suggests that encouragement be given in a more neutral interpersonal relationship. Wechsler encourages the traits of friendliness and warmth in the examiner's repertoire of proper test-administering behaviors. In the most recent edition of the Stanford-Binet Intelligence Scale, Terman and Merrill (1973), however, again stress the necessity for establishment and maintainance of rapport for purposes of obtaining optimal performance levels. The examiner is advised to encourage the subject through frequent and generous praise, but this approach is recommended for effort only, not correct responses.

To summarize, there does seem to be agreement that the testing process should elicit the best possible subject effort and that an examiner's behavior is a variable which may influence test results. In light of these factors, investigators have begun to direct attention upon verbal, nonverbal, and material reinforcers as elements which may increase the level of performance of test subjects.

Numerous studies have been conducted to observe the effects of material and social (verbal) reinforcers upon human behavior. Of particular interest for this study are those studies examining the effect of verbal incentives and tangible rewards upon performance of school-age children. In one of the first systematic investigations in this area, Gilchrist (1916) concluded that for increasing performance praise was significantly superior over blame. One of the first investigations to assess the effect of verbal incentives (praise and reproof) upon intelligence test performance was the work of Hurlock (1924, 1925). She first examined the effects of verbal incentives upon scores of the National Group Intelligence Tests given to third, fifth, and eighth grade children (Hurlock, 1924). Her methodology consisted of administering the tests using a test-retest method with a one week interval. She set up praise, reproof, and control groups for the treatment conditions in the second administration. She concluded that neither praise nor reproof was superior, although both variables were superior to practice (control) only. There were, however, different effects on the basis of age, race, sex, and level of intellectual functioning. She replicated her results in a follow-up study (Hurlock, 1925).

Extending Hurlock's work, Benton (1936) explored the effect of giving verbal praise for performance on the first administration of an intelligence test and promising rewards if the subjects increased their performance level on a second administration. He matched seventh and eighth grade students for age, sex, IQ, and grade placement; however, no significant differences between groups were found.

More recently, Isenberg and Bass (1974) reviewed the current literature concerning this area of study. They report that Feldman and Sullivan (1971) gave the Wechsler Intelligence Scale for Children (WISC) to 72 elementary-age school children matched by grade, sex, and Otis IQ score. One half of the sample received the WISC by the standard method of administration while the other group was under an "enhanced rapport" condition which consisted of friendly conversation throughout the session and verbal reinforcement (praise) for the first correct response in each subtest. Results indicated that significantly higher IQ scores were obtained under the enhanced rapport condition.

In another study Witmer et al. (1971) used not only praise and neutrality but also aversive statements in the form of verbal disapproval as treatment conditions. They randomly assigned 90 matched third and fourth graders to three treatment conditions identified as disapproval, neutral, and approval. All subjects were then administered four WISC subtests. One of the subtests administered was the WISC Block Design subtest which Glasser and Zimmermann (1967) describe as a test of perceptual skills. Those children in the verbal approval condition received praise after making a response to the first item (whether right or wrong) in each WISC subtest and between subtests. Subjects receiving the disapproval heard statements such as, "I thought you could do better than that," after the response to the first item without regard to the correctness of the response. The statement, "That wasn't so good," was delivered between subtests. In the neutral condition no systematic positive or negative reinforcer was offered. It was found that those subjects presented with the verbal approval scored significantly higher on all four subtests than those subjects receiving disapproval. The approval group was superior to the neutral group, which in turn, surpassed the disapproval group; however, these gains were not statistically significant. In summary, the Witmer et al. study offers evidence that perceptual tasks as well as other subtests are influenced by reinforcement conditions. Willcutt and Kennedy (1963) also found praise to be more effective than either reproof or no incentive in performance on a visual perception discrimination task by school-age children.

Another factor which has received some attention for its potential effects on performance is the use of token or material reinforcement. Bergan et al. (1971) investigated the effects of material reinforcement on performance of a perceptual measure, the WISC Block Design subtest. These investigators assigned an equal number of white, fourth grade boys and girls to three groups according to their pretest performance on the WISC Block Design subtest in such a way as to equate the groups for accuracy and speed. Three weeks later the children again performed the tasks of the Block Design subtest in one of the three conditions:

(a) under standardized conditions of administration (control group), (b) under social reinforcement using such words as <u>good</u> and <u>fine</u> for each correct block placement and after the successful completion of the total design, and (c) under token reinforcement conditions with subjects receiving chips which could be traded in for money for achieving the same performance criteria as listed in (b). The findings showed that boys made significant gains in accuracy only under the token reinforcement condition and significant gains on apeed only under social reinforcement. Girls showed significant gains in accuracy under all three treatment conditions but also showed speed losses under all treatments.

Edlund (1972) went one step further in attempting to study the effect of a presumptive reinforcer, chosen on the basis of its high probability of being effective, given contingent on correct responses on an individual intelligence test. He noted that in many studies, e.g., those previously reviewed, the experimenter did not use a known effective reinforcer and the deprivation state of the subjects had not been considered. In addition, precision of reinforcement had not been considered. For example, some subjects had received reinforcement for responding for total score improvement. He suggests that it would be more precise to reinforce only correct responses since an IQ score results from many responses considered correct. The subjects for the study were 79 low-middle and low socioeconomic class children ranging in ages from 5 to 7 years. The subjects were given the Stanford-Binet Intelligence Scale, Form L, under conditions of no reinforcement. Of the initial subject pool, 22 subjects were chosen and matched for intellectual functioning, age, sex, a liking for candy (the presumptive reinforcer), no digestive problems, and parental permission to eat candy. One subject from each pair was randomly assigned to an experimental group and the other to a control group. Seven weeks after the pretest, subjects in the experimental group were given Form M of the test under the condition that subjects were given an M & M candy for each correct answer. Subjects in the control group received Form M of the test under standard conditions of administration. All test administrations were conducted before lunch to insure a high level of food deprivation. A *t*-test for matched pairs was used to evaluate results which showed a statistically significant difference in favor of the reinforced administration.

Other researchers have considered population groups other than children. For example, Husted, Wallin, and Wooden (1971) investigated the effects of using M & M candy as positive reinforcement versus standardized conditions in the administration of the Cattell Infant Intelligence Scale on 40 profoundly retarded children. Significant differences in performance under tangible reinforcement conditions as opposed to control conditions were reported. In addition, Busch and Osborne (in press) investigated tangible reinforcement effects on trainable mental retardates on four measures (Lorge Thorndike Vocabulary and WISC Arithmetic, Picture Arrangement, and Comprehension subtests). Subjects were randomly assigned to test examiners who were blind to the hypotheses of the study. Results indicated that reinforced administration resulted in significantly superior performance on three out of the four dependent measures. Split-half reliability coefficients were computed to assess the effects of reinforcement on the reliability of performance. On three of the four dependent measures, reliability under the reinforced administration condition was higher than the standard administration condition. Magnitude of the treatment effects was slight with correlations between treatment condition and dependent measures ranging between .16 and .18.

Isenberg and Bass (1974) investigated the hypothesis that normal adult subjects perform significantly higher on the Wechsler Adult Intelligence Scale (WAIS) under conditions of verbal or nonverbal reinforcement than under no reinforcement conditions. Forty-eight equally divided, college-age, male and female subjects served in the experiment. Methodology consisted of the WAIS being utilized in a split-half fashion and administered to all subjects with a one week interval between the presentation of both abridged forms. Each subject was assessed under a standard test condition during one session, but received verbal praise or nonverbal reinforcement (nods, smiles, etc.) contingent on correct responses during the second session. Because the WAIS was abbreviated, all subtest scores were doubled so the adjusted scale scores more closely approximated the WAIS norms. Twenty-eight 2 X 2 analyses of variance of the WAIS Scaled scores and Full Scale IQ scores were computed. Findings indicated no significant differences in the scores as a function of treatment conditions; however, the scores revealed a trend toward the hypothesis. More specifically, the WAIS perception test, Block Design, showed an increase as a function of treatment. In summary, the authors concluded that the results suggest verbal and nonverbal behaviors displayed by examiners during testing may have important effects upon test performance of adults. However, the insignificant effects of treatment are of interest in light of the fact that other studies have provided evidence that verbal reinforcement can be significantly effective in increasing test performance of younger subjects. Typically, other studies (Bergan et al., 1971; Witmer et al., 1971) employed matched groups. Since the present study allowed subjects to serve as their own controls, it became more difficult to achieve significant differences. Also, there has been no evidence in the literature to suggest that adult subjects will manifest the same responsiveness to reinforcement conditions as do children on intelligence measures. Therefore, methodological differences may have been responsible for lack of significant treatment effects.

Researchers have also been concerned about effects of reinforcement on test responses as a function of socioeconomic status. Klugman (1944) used the 1937 edition of the Stanford-Binet Intelligence Scale in conducting a cross-cultural study including black and white children. He found that money was somewhat more effective than verbal reinforcement especially when given to black children. Since he used no control group, it was not possible to determine to what extent incentives influenced performance. Tiber and Kennedy (1964) studied the effects of reinforcement on IQ scores of 480 second- and third-graders divided into middle-class white, lower-class white, and lower-class black. The 1960 revision of the Stanford-Binet was administered with incentives (praise, reproof, candy, and no reinforcement) given at the end of each subtest. No significant differences across groups were found.

Fast (1967) used the same methodology as Bergan et al. (1971) in administering the WISC to 30 middle-class and 30 lower-class children with a three month interval between administrations. No significant differences in the performance of the subjects on any of the three conditions were found. Other investigations, however, have found that lower-class children respond better to material than to nonmaterial reinforcers (Cameron & Storm, 1965; Donoviel, 1966; Higgins & Archer, 1968; Swingle & Coady, 1969; Terrell, Durkin, & Wiesley, 1959). Zontine, Richards, and Sharp (1972) provided a more complete examination of the effectiveness of extrinsic reinforcers with lower class children by employing an automated dispenser of reinforcers. The subjects for the study were 72 eight year old, indigent children, matched for race and sex, who were given the Peabody Picture Vocabulary Test-Form A by listening to tape-recorded instructions. Two months later the subjects were randomly assigned to one of three treatment groups: (a) condition 1 which was a standard administration control group, (b) condition 2 where one correct test response was followed by the illumination of a white light and five correct responses were followed by a red light illumination, and (c) condition 3 where children received the same treatments as those subjects in condition 2, but they were also given their choice of edible rewards every time they earned three red lights. The findings of the study revealed no treatment, sex, or interaction effects to be statistically significant; however, there was a main effect for race. Black children improved their performance significantly across treatments. Although methodologically sound, this study is somewhat unrealistic in terms of behavior usually shown by examiners. Therefore, generalization of results are somewhat questionable.

More recently, Galdieri, Barcikowski, and Witmer (1972), in a well-controlled investigation which considered statistical power and sample size, found no significant differences between middle- and lower-class children in their responsiveness to verbal approval and no verbal approval modes of test administration. These results are in conflict with those studies which have found middle-class subjects to be more responsive to nonmaterial incentives while lower-class subjects tend to be more responsive to material incentives. However, the authors explain that the results indicate the "interaction effect of verbal incentives and cultural differences may not be strong enough to worry about in an individual testing situation" (p. 408).

To summarize, the literature has shown considerable variation among studies with regard to the conditions under which reinforcement was administered. For example, some investigations (Bergan et al., 1971; Edlund, 1972; Fast, 1967; Zontine et al., 1972) were characterized by reinforcement given contingently for correct responses. In other studies (Feldman & Sullivan, 1971) both contingent and noncontingent reinforcement were given while Witmer et al. (1971) administered reinforcement to subjects regardless of correctness of response. Certainly it can be concluded that investigators do not agree on the optimal procedure of dispensing reinforcement. Cofer and Appley (1964) suggest that reinforcement effects may differ as to whether reinforcement is contingent on a specific correct response or is contingent upon overall total performance. By reinforcement of total performance, the subject's motivation to perform may increase while the reinforcement of only correct responses may assist the subject to develop cues to aid in the development of an appropriate response set. Some investigators (Isenberg & Bass, 1974) suggest that reinforcement effects on test responses deserve additional clarification because of inconsistent research findings; therefore, this area is open to further investigation.

Moreover, relating specifically to this study, it has been demonstrated that responses to perceptual tasks have a functional relationship to the presentation of reinforcement; however, the effect of positive reinforcement on a full range of perceptual tasks which are assessed by a standardized instrument is still open to more investigation. Effects of other variables, e.g., sex, race, socioeconomic status, etc., remain to be clarified.

Application of Reinforcement to Perceptual Tasks

Vernon (1970) observed that the relationship between perception and motivation gained impetus in the 1940s leading to much study and experimentation. Henle (1955) noted that there seem to be several ways in which perception may be influenced by motivation. The use of motivation increases arousal and increases attention to perceive and to explore the perceptual field. Gaines (1972) stated that rewards do facilitate correct perceptual performance and he advocates liberal use of incentives.

Laberge, Tweedy, and Ricker (1967) rewarded observers for perceptual task performance, thereby increasing arousal, speed, and accuracy of perception. He instructed subjects that they would gain 20 points for pressing a button as soon as they perceived a particular color. Results indicated that the rewarded group perceived the color more quickly than did another group who were promised only a single point. In an experiment with children, Smock and Rubin (1964) used 9 to 12 year old children as subjects in a perceptual matching task. They promised a material reward (toy) contingent on perceiving and matching of animal pictures and irregular shapes. A control group received no incentives for correct performance. The rewarded group perceived and matched the pictures and shapes more accurately than did the control group. Speed of performance, however, was not affected as rewards were given for accuracy only.

Smith, Parker, and Robinson (1951) set up an experiment requiring subjects to estimate the number of dots in groups of dots presented via a tachistoscope. One group of subjects was reinforced for every correct response while the subjects in the second group received increasing amounts of reinforcement with the increasing number of dots in each set presented. It was found that the second group tended to over-estimate at the beginning of the trials but ceased to over-estimate by the 20th trial.

Bahrick, Fitts, and Rankin (1952) have demonstrated that reward improves accuracy of central perception; or to state in another way, reward narrows the span of attention. He formulated a tracking task for central vision while simultaneously exposing lights in the periphery. Results showed that rewards given for good performance early in the task improved tracking performance. However, no improvement in the detection of peripheral light signals was obtained even though subjects were told that this condition would increase the amount of reward.

It has been demonstrated that perceptual response can be increased even when observers are not aware of the contingency conditions. Rigby and Rigby (1956) presented rewards to children when particular letters turned up in a cube tossing task. Reinforcement in the form of tokens was given which could be exchanged later for back-up candy reinforcers.

Upon exposing tachistoscopically the letters at a later time, the letters which had been rewarded previously were perceived more rapidly than those not rewarded. They concluded that the reward condition may have directly accelerated perception and established cues for perceiving particular letters. Fisch and McNamara (1963) demonstrated a similar effect. Essentially, they set up a task which required adult observers to judge the mid-point of various distances. After an increasing number of trials verbally reinforcing incorrect responses, more and more judgments were made contrary to the correct perception. The control group who received no comment increased their tendency to judge correctly. It can thus be concluded that reinforcement can have a directional effect on perception.

Other studies have investigated reinforcement as a variable in influencing correct visual discriminations and in increasing visual acuity. Giddings and Lanyon (1974) demonstrated that visual acuity can be increased by using reinforcement techniques. College-age myopic volunteers participated in five blocks of 24 trials in a conditioning task. The target stimuli were Landolt rings. Trial blocks of contingent social approval for a correct response were alternated with noncontingent blocks in which approval was delivered randomly. Results suggested that contingent social reinforcement result in increased visual acuity.

There have been several investigations and reports concerning the teaching of visually discriminated behavior in functionally blind subjects. Brady and Lind (1961) taught a patient with a diagnosis of hysterical blindness to respond discriminatively to visual stimuli by employing operant techniques. Grosz and Zimmerman (1965) suggested that the verbal reporting of hysterical blindness is manipulable in terms of its consequences. These investigators suggested that one patient's verbal reports of blindness were maintained by a wide variety of reinforcers, e.g., public welfare funds. Experimentally, they (Zimmerman & Grosz, 1966) demonstrated that the ability of a patient to see was contingent on a schedule of social consequences.

In another study Stolz and Wolf (1969) sought to modify the visual discrimination behavior of an adolescent, functionally blind retardate. Reinforcers for correct responses were praise accompanied by a sip of soft drink or milk, or by cookies, sweetened cereal, or candy. A two-choice discrimination task using triangles, blocks, and different colored pieces of paper was employed. The method consisted of the subject selecting one of the stimuli which was designated as "the correct one" by the experimenter. Reinforcement was delivered for correct responding after each trial. The results indicated that for the first five sessions, discriminations were at chance level on a variety of stimuli pairs. After the fifth session the subject was given shaping tasks where stimuli differed in size and color. Correct responses to the shaping stimuli were significantly different from chance. When papers and blocks of the same size but different colors were re-introduced, the subject's responses were no longer randomly selected. It was determined that the subject could be trained via a reinforcement procedure to discriminate visually and, therefore, was capable of seeing.

In a second experiment with the same subject, visual acuity was taught using reinforcement procedures. Two tokens were required to be earned before reinforcement was delivered and incorrect responses were followed by a withdrawal of stimuli and by a 10-second pause where the experimenter ignored the subject. Stimuli were upper-case letters of the alphabet with the correct stimulus being the letter E. After training, the subject was able to discriminate the letter E consistently down to 12-point letter size. The subject exhibited visual acuity to the extent of possibly being able to read books for the partially-sighted.

Operant methodology has also been used to study visual discrimination in infants and children. McKenzie and Day (1971) investigated visual discrimination of simple patterns by young infants. The dependent variable of discrimination by the infants was right and left head turns. Reinforcement for correct discrimination was delivered for approximately 5 seconds; reinforcement consisted of smiling, praising, shaking a rattle, or showing the baby a colored toy. Pretraining, training, and testing sessions were conducted. Results demonstrated that reinforcement was capable of teaching visual discrimination behavior in young infants.

As in standardized test administration, social class and nature of incentive have been given consideration in visual discrimination learning. Terrell and Kennedy (1957) found that rural, lower-class children require significantly more trials to learn a discrimination response when given only a light flash as positive feedback than when given material incentives. On the other hand, middle-class children learned faster in the light flash condition than in a material incentive condition.

Terrell et al. (1959) investigated the interaction between social class and type of reward. They hypothesized that a nonmaterial incentive is as effective as a material incentive for middle-class subjects while lower-class subjects are influenced more by material incentives. Their experiment contained two groups, one group receiving a nonmaterial reward (light flash) while the other group received both material and nonmaterial rewards for correct responding. Subjects from low- and middle-social classes were randomly assigned to the two incentive conditions. Results confirmed that middle-class subjects learn quicker when given a nonmaterial reward while material reward speeds learning in lower-class children. The authors point out several interesting implications of the results. They speculated that parents of middle-class children place a greater emphasis on learning for learning's sake than do lower-class parents. Middle-class subjects tend to be reinforced by the mere indication that they are progressing. Perhaps lower-class children are too preoccupied with obtaining life's necessities; therefore, symbolic incentives have little meaning. Also, lower-class children may be more deprived of the specific material reinforcer, e.g., candy. Finally, the middle-class child may be able to engage in effective imaginative activity during learning, whereas the lower-class child does not possess this capacity. If so, it would tend to follow that the middle-class child would learn more effectively under a symbolic, nonmaterial condition.

In a follow-up study, Norton, Versterg, and Rogers (1970) investigated social class and type of incentive using a different discrimination task. Verbal reward and verbal reward combined with candy were used as incentives. The results indicated that the lower-class group learned the discrimination task slower than did the higher status group; however, there was a tendency for all subjects in the verbally rewarded group to be superior in performance to that of the subjects in the combined reward condition. This finding is contradictory to previous research. The authors speculate that the method of dispensing the candy reinforcement was distracting to the subjects in the combined condition. In any event, the conclusions drawn are that verbal reinforcement is no better or worse than a combination of verbal and material reinforcement and that the effect is the same for both high and low socioeconomic groups.

Lastly, results of the Norton et al. (1970) study demonstrated that higher-status children performed better on a discrimination task than did lower-class children. Lietz (1972) also investigated perceptual-motor abilities of disadvantaged and advantaged kindergarten children. He administered a revision of the Purdue Perceptual-Motor Survey to 50 disadvantaged (from economically deprived homes where annual income was less than $3000) and 50 advantaged children. Results showed that boys and girls had equivalent performance whether disadvantaged or advantaged; however, the advantaged children had significantly better scores on the test than did the disadvantaged children.

To summarize briefly, these studies indicate that positive reinforcement does have a contingent influence on visual perception. According to the above results positive reinforcement increases perceptual discrimination skills, improves accuracy of perceiving, increases acuity, increases attention skills, and can have a directional effect to produce incorrect perception when reinforcement is delivered contingent upon incorrect responding. Attribute variables which have been found to influence reinforcer effectiveness are social class of the subject and nature of the incentive. Although there is evidence that middle-class subjects are more influenced by social rewards while lower-class subjects value material rewards, no definitive conclusions are available.

Characteristics of the Instruments

The dependent measure for the experiment was the Frostig Developmental Test of Visual Perception (DTVP) (Frostig et al., 1964). The test consists of five subtests: Test I, Eye-Motor Coordination; Test II, Figure-Ground perception; Test III, Constancy of Shape perception, Test IV, Position in Space perception; and Test V, Spatial Relationships perception. According to Frostig (Maslow et al., 1964) the DTVP taps perceptual and visual-motor skills of recognition, simple motor behavior, and copying ability.

Test materials include the following items: (a) a 35 page test booklet, the back cover of which serves as a scoring sheet, (b) 11 demonstration cards, and (c) three transparent overlays for scoring subtests Ic, Id, and Ie. The examiner is required to have four well-sharpened colored pencils in contrasting colors: red, brown, blue, and green; also a regular or a primary pencil, used according to the child's preference, is required for kindergarten subjects. The authors also recommend that a large, smooth desk top of proper height be provided with adequate light and room ventilation.

The standardization of the DTVP used a sample of 2,116 students in southern California schools. The authors give little information about the sample; however, minority and low socioeconomic groups were poorly represented. No black subjects were included in the standardization sample.

Test-retest product-moment reliability coefficients are reported to be .98 (Frostig, Lefever, & Whittlesey, 1961) and .80 (Maslow et al., 1964) for perceptual quotient scores. Test-retest correlations for subtest scale scores are reported to range from .42 (Subtest II) to .80 (Subtest III) (Maslow et al., 1964). Split-half reliability product-moment correlation coefficients corrected by the Spearman-Brown formula are reported to range from .78 to .89 for total scores of ages 5 to 9 years. For the same age range, coefficients for the five subtests range from .35 to .96. For ages 5 to 6 years (60 to 71 months) the following split-half reliability coefficients are reported: .59 (Subtest I), .93 (Subtest II), .67 (Subtest III), .70 (Subtest IV), .85 (Subtest V), and .89 (Total Raw Score) (Maslow et al., 1964).

The standardization monograph (Maslow et al., 1964) reported several validity studies. A product-moment correlation of .441 and a Chi-Square comparison of 45.6, $p < .001$, were reported for teacher ratings of classroom adjustment and scores on the DTVP. McBeath (1966) confirmed the Frostig hypothesis that there is a high degree of agreement between visual perception deficits and classroom adjustment. She tested the hypothesis that there is a significant relationship between teacher-rated classroom adjustment and scores on the DTVP. Her hypothesis was accepted at the .05 level.

According to Chissom (1965) the literature suggested that academic achievement prediction power of the DTVP is best for youngsters up to the third grade. Also, results of studies (Ohmnacht & Olson, 1968; Olson, 1966; Sprague, 1963; Trussell, 1967) indicate significant relationships between reading readiness achievement scores and DTVP scores; however, little support exists for using the DTVP to diagnose specific reading disabilities.

The Two-Factor Index of Social Position (Hollingshead, 1957) was used to stratify subjects into levels of social class. The scale utilizes the factors of occupation and level of education to determine social position. According to Hollingshead (1957),

> Occupation is presumed to reflect the skill and power individuals possess as they perform the many maintenance functions in the society. Education is believed to reflect not only knowledge, but also cultural tastes. The proper combination of these factors by the use of statistical techniques enable (sic) the researcher to determine within approximate limits the social position an individual occupies in the status structure of our society. (p. 2)

Summary

The review of literature included investigations which were reported under three headings: (a) the nature of positive reinforcement, (b) the effects of the application of reinforcement on responses of standardized tests, and (c) the relationship of reinforcement to the area of perception in general. Psychometric characteristics and rationale of the dependent measure and classification instrument were described.

Findings summarized from the literature suggest that positive reinforcement in the form of verbal (social), nonverbal, and tangible incentives is effective in increasing performance scores on standardized tests as well as influencing and altering visual perception. Specifically, it was demonstrated that the ability to learn visual discriminations and the power of visual acuity could be increased by the contingent use of positive reinforcement. Other variables, e.g., race, sex, and socioeconomic status, have also been found to exert an interaction effect in the application of reinforcement to standardized tests and perceptual tasks.

CHAPTER III

METHODS

The purpose of this study was to investigate the effects of positive reinforcement on visual perception skills of kindergarten youngsters. The primary dependent measure was scores obtained on the Frostig Developmental Test of Visual Perception (DTVP) under several treatment conditions.

This chapter will describe the subjects selected for the study, use of the dependent measure, experimental procedures, treatment conditions, reliability measurements, and data analysis.

Subjects

The total number of subjects participating in the experiment was 80. Of the total number of subjects, 40 were females and 40 were males. All subjects were Caucasian. This singular racial factor most closely approximated the norm population in the standardization of the dependent measure.

The subjects were randomly selected from a pool of students attending public kindergarten in Davidson County, North Carolina. All subjects were enrolled in regular classes in their respective kindergartens. Subjects ranged in chronological age from 59 to 75 months. (See Appendices A and B for samples of the explanatory letter and permission form which were sent to the parents.)

Subjects were dichotomized into middle- and lower-socioeconomic status groups by examining occupational and educational level of the parents; this information was obtained from the returned permission forms. The Two-Factor Index of Social Position (Hollingshead, 1957) was utilized in order to make the social class determination. Middle-class children were designated as obtaining an Index position score ranging from 11 to 43 while lower-class children were designated by obtaining an Index score between 44 and 77. This procedure of utilizing score ranges for social class designation was consistent with the author's recommended use of the instrument.

Measures

The dependent measure was the Frostig Developmental Test of Visual Perception (DTVP) (Frostig et al., 1964). The test, which consists of five separate subtests purporting to measure different perceptual skills, was administered to all subjects under one of four treatment conditions to be described in a later section. The DTVP yields five separate subtest scores, a total Scaled score, and a Perceptual Quotient score.

Procedures

All subjects were tested under one of four treatment conditions. Subjects were randomly assigned (20 per group) to each treatment condition. An equal number of males and females from both social classes comprised each treatment group.

Testing sessions were conducted individually with tests being administered in an appropriate room of the subject's kindergarten setting. Administration of the tests under treatment conditions was conducted under recommended test conditions. The experimenter, who served as the only examiner, administered all treatments. The experimenter was experienced in administering and scoring the DTVP in clinical as well as in educational settings.

The administration of the subtests was in the same order to all subjects. This procedure closely approximated actual testing procedures in an educational or clinical setting. Also, this procedure allowed the investigator to evaluate the effects of reinforcement on responses to each individual subtest.

Treatment Conditions

No reinforcement (NR). The subjects in this condition received the DTVP under conditions with no reinforcement presented by the examiner. The examiner followed standard testing procedures except that no statements of praise or encouragement were rendered during the test administration. Subjects in the NR condition were given the opportunity to select candy after completing the test. Subjects had no knowledge beforehand that they would be given candy. The NR group served as a control.

Social reinforcement (SR). When tested under this condition, the subjects were reinforced by the examiner whenever they made a correct response on the test. Social reinforcement referred to examiner statements, e.g., "That's good," "Very good," "Great," "Okay," and "Excellent." Statements were made in a positive, pleasant tone of voice. Subjects in the SR condition were also given the opportunity to select candy after completing the test.

Material reinforcement (MR). When tested under this condition, the subjects were reinforced by the examiner whenever they made a correct response on the test. Material reinforcement consisted of certain types of "penny" candy (M & M candies, jelly beans, bite-size Tootsie Rolls, and chocolate kisses) which were selected by the subjects, according to their preference, immediately before test administration. Subjects were reinforced with their chosen candy only; no social feedback was given.

Social and material reinforcement (SMR). Usually in educational situations with normal children, material reinforcement is combined with social reinforcement. Therefore, the SMR condition combined the procedures of SR and MR treatment conditions in order to deliver social plus material reinforcement contingent on correct DTVP responses.

Reliability

Audio tape recordings were made during the treatment sessions. In order to determine the experimenter's consistency of administering treatment and adhering to proper testing procedures, two independent judges listened to the audio tape recordings. The test manual and stated treatment procedures served as rating standards. Both judges subjectively rated two five-minute audio segments of eight test administrations from each of the four treatment conditions. The tests and five-minute segments were selected for rating in a random fashion. Reliability coefficients were expressed as a percentage of agreement between the two judges. Percentage of agreement was defined as number of agreements divided by the number of disagreements plus the number of agreements multiplied by 100. (See Appendix C for sample copy of rating form with judging criteria.)

Although the scoring criteria of the DTVP are objectively determined, some judgment, nevertheless, on the part of the scorer is required. Therefore, one independent scorer was employed to rate 40 randomly selected DTVP test booklets. The reliability coefficient was expressed as a percentage of agreement between the independent scorer and the experimenter's scoring of the test.

Analysis of Data

A factorial design was utilized. The independent variables were social class of subjects, sex of subjects, and type of treatment administered, while the dependent variable was DTVP scores. Data were analyzed by employing a factorial three-way analysis of variance (treatment X social class X sex) computation of each subtest Scaled, total Scaled, and Perceptual Quotient scores. Seven analyses (five for each subtest Scaled score, one for the total Scaled score, and one for the Perceptual Quotient score) were performed. In addition, the variability of subject's subtest Scaled scores under the four treatment conditions was subjected to a three-way ANOVA. Sums of squares and F scores were computed by using a three-way ANOVA program (Service, 1972) on the computer of the Academic Computing Center of The University of North Carolina at Greensboro. Figure 1 depicts the representation of the 4 X 2 X 2 factorial design.

Significant differences revealed by the analysis of variance were further analyzed by the Newman-Keuls procedure for post-hoc interpretation of significant results. Magnitude of treatment effects was tested by the Omega Square (W^2) method of correlation (Hays, 1963).

In order to assess the effects of the treatment conditions on the reliability of the DTVP, split-half reliability coefficients were computed for each treatment condition. The obtained Pearson coefficients were corrected by the Spearman-Brown formula (Downie & Heath, 1970). Pearson product-moment correlation coefficients were computed by using the correlation computer program by Service (1972). (See Appendix D for sample of split-half reliability worksheet.)

		Treatment							
		A_1 (NR)		A_2 (SR)		A_3 (MR)		A_4 (SMR)	
	Sex	(Male C_1	Female) C_2	(Male C_1	Female) C_2	(Male C_1	Female) C_2	(Male C_1	Female) C_2
Social Class	B_1 (Low)	$A_1B_1C_1$	$A_1B_1C_2$	$A_2B_1C_1$	$A_2B_1C_2$	$A_3B_1C_1$	$A_3B_1C_2$	$A_4B_1C_1$	$A_4B_1C_2$
	B_2 (Middle)	$A_1B_2C_1$	$A_1B_2C_2$	$A_2B_2C_1$	$A_2B_2C_2$	$A_3B_2C_1$	$A_3B_2C_2$	$A_4B_2C_1$	$A_4B_2C_2$

Figure 1. Design Representation

CHAPTER IV

RESULTS

Subjects

Subjects were dichotomized into two socioeconomic classes, low and middle, using the Hollingshead Two-Factor Index of Social Position (1957). For purposes of the present study, social position scores ranging from 11 to 43 were designated as middle class and social position scores ranging from 44 to 77 were designated as low class. In the low-class group, mean Index scores ranged from 51.7 to 58.1 with a total mean score of 54.7 being obtained for the combined groups. The middle-class mean Index scores ranged from 28.1 to 30.1; the mean score for the combined treatment groups was 29.5. Table 1 presents the mean social position scores for each treatment group.

Reliability

Two independent judges made subjective appraisals of eight randomly-selected audio tape recordings from each treatment condition. (See Appendix C for sample rating sheet with criteria.) The judges rated the examiner's adherence to following the standardized instructions in administering the instrument and adherence to stated conditions of administering the treatment. Reliability between raters was calculated by dividing the number of agreements of both judges by the number of disagreements plus the number of agreements multiplied by 100.

Coefficients of reliability for agreement between the two judges that the experimenter adhered to the standard test administration ranged

Table 1

Mean Social Position Scores for

Each Treatment Condition

Treatment Condition	Social Class Low	 Middle
NR	58.1 (9.48)	28.1 (11.79)
SR	51.7 (5.05)	29.8 (5.93)
MR	53.6 (5.87)	30.1 (6.07)
SMR	55.5 (9.12)	29.9 (6.24)
Combined Treatment Groups	54.7 (7.38)	29.5 (7.51)

Note. The numbers in parentheses are standard deviations.

from a low of .69 to a high of .81 across treatment groups; the overall reliability coefficient of agreement was .77. Reliability coefficients ranging from .88 to 1.00 with an overall total of .91 were obtained for judges' agreement that the experimenter adhered to the stated conditions of administering treatment. Tables 2 and 3 present reliability measures between the two judges for adherence to standardized instructions and adherence to treatment conditions respectively. For combined treatment conditions the judges assigned 77.3% of their ratings in the "Excellent" category and 22.7% in the "Good" category for the experimenter's adherence to DTVP standardized administration instructions. Also, 95.3% and 4.7% of the ratings were assigned in the "Excellent" and "Good" categories respectively for the experimenter's adherence to the stated procedures of administering treatment for the total combined treatment conditions. No ratings were assigned in the remaining categories. Tables 4 and 5 present the percentages of ratings of both judges which were assigned in each rating category of the four treatment groups.

Reliability coefficients were also computed for agreement between one independent test scorer and the experimenter's scoring of the test. The independent judge scored 10 randomly selected tests from each of the four treatment groups; a total of 40 tests were rated. Reliability between the independent scorer and experimenter was calculated by dividing the number of agreements of both scorers by the number of disagreements plus the number of agreements multiplied by 100. An overall reliability coefficient of 98.44 was obtained for scorers' agreement in scoring the DTVP. Table 6 presents the reliability coefficients for agreement between the independent scorer and experimenter.

Table 2

Reliability Measures Between Two Judges for Experimenter's Adherence to DTVP Standardized Administration Instructions for All Treatment Conditions

Treatment Condition	Reliability Coefficient
NR	.69
SR	.81
MR	.81
SMR	.75
Mean Total	.77

Table 3

Reliability Measures Between Two Judges for Experimenter's Adherence to Stated Conditions of Administering Treatment for All Treatment Conditions

Treatment Condition	Reliability Coefficient
NR	1.00
SR	.88
MR	.88
SMR	.88
Mean Total	.91

Table 4

Percentages of Judges' Ratings Assigned in Each Category of the Experimenter's Adherence to DTVP Standardized Administration Instructions for All Treatment Conditions[a]

Treatment Condition	Poor	Rating Categories Fair	Good	Excellent
NR	0	0	21.9	78.1
SR	0	0	21.9	78.1
MR	0	0	21.9	78.1
SMR	0	0	25.0	75.0
Total Combined Treatment Conditions	0	0	22.7	77.3

Note. See Appendix C for rating criteria.

[a]Expressed as percents.

Table 5

Percentages of Judges' Ratings Assigned in Each Category of the Experimenter's Adherence to Stated Procedures of Administering Treatment for All Treatment Conditions[a]

	Rating Categories		
Treatment Condition	Poor	Good	Excellent
NR	0	0	100.0
SR	0	6.3	93.7
MR	0	6.3	93.7
SMR	0	6.3	93.7
Total Combined Treatment Conditions	0	4.7	95.3

Note. See Appendix C for rating criteria.

[a]Expressed as percents.

Table 6

Reliability Coefficients Between Two Test Scorers

for Agreements in Scoring the DTVP

Treatment Groups	Reliability Coefficient
NR	98.53
SR	98.33
MR	97.96
SMR	98.92
Mean Total	98.44

Thus, for purposes of the present investigation, the procedures of dispensing treatment and subsequent scoring of the dependent measure were considered to be sufficiently reliable. In addition, the effect of experimenter bias was considered to be negligible.

Effects of Treatment

Seven three-way (treatment X social class X sex) analyses of variance of the five DTVP subtest Scaled scores, of the total subtest scores, and of the Perceptual Quotient (PQ) scores were computed. Tables 7-13 present summaries for the analyses of the subtest and the total scores. On DTVP Subtests I (Eye-Motor Coordination) and II (Figure Ground) there were no significant main or interaction effects. Therefore, for Subtests I and II the major hypotheses of the study were not supported.

On Subtest III (Form Constancy) there was a significant main treatment effect, F (3, 64) = 2.81 $p < .05$, and a significant treatment X sex interaction effect, F (3, 64) = 2.98, $p < .05$. The Omega Square calculation for magnitude of the treatment and interaction effects, however, was relatively weak (W^2 = .058 and .063 respectively). The hypothesis of a main treatment effect was supported.

On Subtest IV (Position in Space) there was a highly significant main treatment effect, F (3, 64) = 9.28, $p < .001$. The magnitude of the treatment effect was somewhat higher, accounting for 25% of the variance. The hypothesis of a main treatment effect was supported.

The analysis of Subtest V (Spatial Relations) produced a highly significant main treatment effect, F (3, 64) = 7.31, $p < .001$. The Omega Square (W^2) calculation for magnitude of treatment effect was .19, i.e., 19% of the variance was accounted for by the treatment variables. Again, the hypothesis of a main treatment effect was supported. It was also found that the treatment X sex interaction for subtest V approached significance, $\underline{F}$ (3, 64) = 2.55, $\underline{p} < .07$.

Finally, for the total Scaled scores and for the Perceptual Quotient scores, significant main treatment effects were found, $\underline{F}$ (3, 64) = 5.38, $\underline{p} < .01$ and $\underline{F}$ (3, 64) = 6.56, $\underline{p} < .001$ respectively. The Omega Square ($\underline{W}^2$) analysis for the strength of association of treatment accounted for 14% and 18% respectively of the total variability. There were no significant sex, social class, or interaction effects. The hypothesis that there will be a significant main effect for kind of reinforcement presentation on examinee performance for total test performance was supported. The remainder of the hypotheses were not supported by the analyses.

In order to determine which types of reinforcement presentation, i.e., no reinforcement (NR), social reinforcement (SR), material reinforcement (MR), or social plus material reinforcement (SMR), were significant in producing DTVP score increases, Newman-Keuls tests of mean differences for Subtests III, IV, V, and total test performance were computed. In addition, the treatment X sex interaction effect on Subtest III was subjected to the Newman-Keuls test. Summaries of the Newman-Keuls tests are presented in Tables 14-19.

For Subtest III the Newman-Keuls test demonstrated that social reinforcement presentation (SR condition) produced significantly higher ($\underline{p} < .05$) DTVP Scaled scores than did the NR condition. There were no other significant treatment mean comparisons for Subtest III. For the

Table 7

Analysis of Variance for Subtest I

(Eye-Motor Coordination)

Source	*df*	*SS*	*MS*	*F*
Treatment (A)	3	112.44	37.48	.76
Social Class (B)	1	86.11	86.11	1.76
Sex (C)	1	49.61	49.61	1.01
A X B	3	78.44	26.14	.53
A X C	3	125.34	41.78	.85
B X C	1	78.01	78.01	1.59
A X B X C	3	131.74	43.91	.89
Residual	64	3140.00	49.06	

$p > .05$.

Table 8

Analysis of Variance for Subtest II

(Figure Ground)

Source	df	SS	MS	F
Treatments (A)	3	4.70	1.57	.93
Social Class (B)	1	2.45	2.45	1.46
Sex (C)	1	.05	.05	.03
A X B	3	4.65	1.55	.92
A X C	3	6.25	2.08	1.24
B X C	1	1.80	1.80	1.07
A X B X C	3	1.10	.37	.89
Residual	64	107.20	1.67	

$p > .05$.

Table 9

Analysis of Variance for Subtest III

(Form Constancy)

Source	*df*	*SS*	*MS*	*F*
Treatments (A)	3	38.10	12.70	2.81*
Social Class (B)	1	7.20	7.20	1.59
Sex (C)	1	5.00	5.00	1.10
A X B	3	12.30	4.10	.91
A X C	3	40.50	13.50	2.98*
B X C	1	.80	.80	.18
A X B X C	3	26.70	8.90	1.97
Residual	64	289.60	4.52	

*$p < .05$.

Table 10

Analysis of Variance for Subtest IV

(Position in Space)

Source	df	SS	MS	F
Treatment (A)	3	85.14	28.38	9.28*
Social Class (B)	1	1.51	1.51	.49
Sex (C)	1	.11	.11	.04
A X B	3	9.64	3.21	1.05
A X C	3	1.84	.61	.20
B X C	1	1.01	1.01	.33
A X B X C	3	1.14	.38	.12
Residual	64	195.60	3.06	

*$p < .001$.

Table 11

Analysis of Variance for Subtest V

(Spatial Relations)

Source	df	SS	MS	F
Treatments (A)	3	20.14	6.71	7.31*
Social Class (B)	1	.11	.11	.12
Sex (C)	1	1.51	1.51	1.65
A X B	3	1.24	.41	.45
A X C	3	7.04	2.35	2.55
B X C	1	.31	.32	.34
A X B X C	3	.24	.08	.09
Residual	64	58.80	.92	

*$p < .001$.

Table 12

Analysis of Variance for Total

Subtest Scaled Scores

Source	df	SS	MS	F
Treatments (A)	3	451.24	150.41	5.38*
Social Class (B)	1	6.61	6.61	.24
Sex (C)	1	9.11	9.11	.33
A X B	3	85.74	28.58	1.02
A X C	3	109.64	36.55	1.31
B X C	1	17.11	17.11	.61
A X B X C	3	47.44	15.81	.55
Residual	64	1788.00	27.94	

*$p < .01$.

Table 13

Analysis of Variance for Perceptual

Quotient Scores

Source	df	SS	MS	F
Treatments (A)	3	1525.34	508.45	6.56*
Social Class (B)	1	43.51	43.51	.56
Sex (C)	1	52.81	52.81	.68
A X B	3	329.44	109.81	1.42
A X C	3	267.54	89.18	1.15
B X C	1	30.01	30.01	.39
A X B X C	3	80.54	26.85	.35
Residual	64	4960.00	77.50	

*$p < .001$.

Table 14

Newman-Keuls Analysis of Treatment

Mean Differences for Subtest III

	Treatment Conditions			
	NR	MR	SMR	SR
NR		1.05	1.55	1.80*
MR			.50	.75
SMR				.25
SR				

*$p < .05$.

Table 15

Newman-Keuls Analysis of Treatment X Sex

Mean Differences for Subtest III

NR Condition

	Male	Female
Male		1.1
Female		

SR Condition

	Male	Female
Male		2.3*
Female		

MR Condition

	Female	Male
Female		1.6
Male		

SMR Condition

	Male	Female
Male		.2
Female		

Males

	NR	SR	SMR	MR
NR		1.2	2.0	2.4
SR			.8	1.2
SMR				.4
MR				

Females

	MR	NR	SMR	SR
MR		.3	1.4	2.7*
NR			1.1	2.4*
SMR				1.3
SR				

*$p < .05$.

Table 16

Newman-Keuls Analysis of Treatment

Mean Differences for Subtest IV

Treatment Conditions

	NR	MR	SMR	SR
NR		.6	.8	2.75*
MR			.2	2.15*
SMR				1.95*
SR				

*$p < .01$.

Table 17

Newman-Keuls Analysis of Treatment

Mean Differences for Subtest V

	Treatment Conditions			
	NR	MR	SMR	SR
NR		.15	.15	1.25*
MR				1.10*
SMR				1.10*
SR				

*$p < .01$.

Table 18

Newman-Keuls Analysis of Treatment

Mean Differences for Total

Scaled Scores

	Treatment Conditions			
	NR	MR	SMR	SR
NR		2.15	3.80	6.50**
MR			1.65	4.35*
SMR				2.70
SR				

*$p < .05$.

**$p < .01$.

Table 19

Newman-Keuls Analysis of Treatment

Mean Differences for PQ Scores

Treatment Conditions				
	NR	MR	SMR	SR
NR		3.9	7.15*	11.90**
MR			3.25	8.00*
SMR				4.75
SR				

*$p < .05$.

**$p < .01$.

treatment X sex interaction, DTVP mean differences for males were insignificant while for females the SR condition produced significantly higher ($p < .05$) DTVP scores than did the NR and MR conditions. Also, females produced significantly higher ($p < .05$) DTVP scores than males in the SR condition. Comparisons for other treatment X sex interaction mean differences yielded statistically insignificant results.

For Subtest IV the Newman-Keuls test demonstrated that social reinforcement (SR) presentation produced significantly higher ($p < .01$) DTVP scores than did the NR, MR, and SMR conditions. There were no additional significant mean comparisons for Subtest IV.

For Subtest V the Newman-Keuls test demonstrated that the social reinforcement (SR) presentation produced significantly higher ($p < .01$) DTVP scores than did the NR, MR, and SMR conditions. Other mean comparisons for this subtest yielded statistically insignificant results.

Figure 2 illustrates graphically the treatment mean differences of the five DTVP subtests which were confirmed by the Newman-Keuls tests. For Subtests I and II there is little difference in the Scaled scores across treatments. However, beginning with Subtest III, Scaled score differences become apparent. The SR condition produced the highest DTVP Scaled scores for Subtests III, IV, and V.

For the total test performance as measured by the total Scaled scores, the Newman-Keuls test demonstrated that social reinforcement (SR) presentation produced significantly higher mean scores ($p < .01$ and $p < .05$ respectively) than did the NR and MR conditions. The SR versus the SMR mean difference was not significant. Also, the SMR condition was close to achieving significance ($p < .10$) over the NR condition. Other mean differences were found to be insignificant.

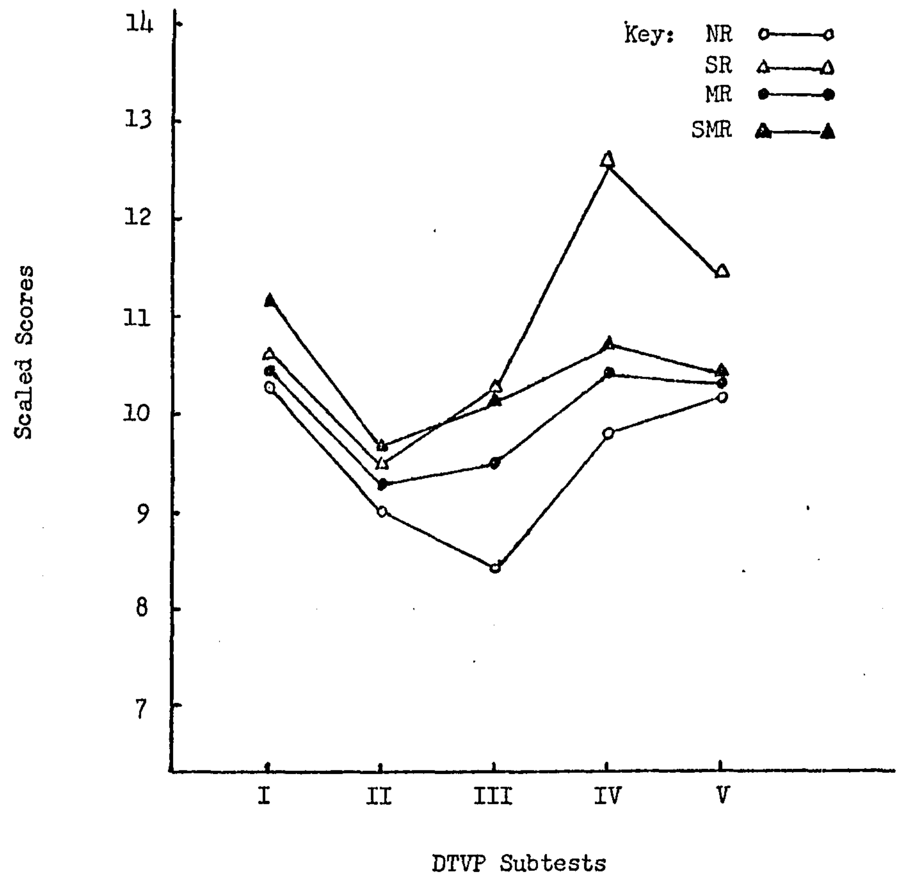

Figure 2. Mean Subtest Scaled Scores for All Treatment Conditions

The second measure of total test performance, the Perceptual Quotient score (a deviation score defined in terms of constant percentiles) was also analyzed by the Newman-Keuls test for significant mean differences. It was found that the SR condition produced significantly higher ($p < .01$ and $p < .05$ respectively) mean DTVP scores over the NR and MR conditions. Also, the SMR condition mean score was significantly higher ($p < .05$) than the NR mean score. There were no other significant mean comparisons.

Figures 3 and 4 illustrate graphically the treatment mean differences of the total Scaled scores and the Perceptual Quotient scores. The graphical representations are confirmed by the Newman-Keuls tests. As indicated, the social reinforcement presentation produced significantly higher total Scaled scores and PQ scores than other treatment conditions. For the PQ scores, the SMR condition was successful in producing a significantly higher score over the control NR condition.

Variability of Subtest Scores

The variability of DTVP subtest scores under the four treatment conditions was subjected to a three-way analysis of variance. The analysis yielded a significant main treatment effect, $F\ (3, 64) = 5.23$, $p < .01$ and a significant main social class effect, $F\ (1, 64) = 6.09$, $p < .05$. The Omega Square (W^2) calculation for magnitude of treatment effect was .14 for treatment and .06 for social class. There were no additional main or interaction effects. Table 20 reports the mean DTVP variability scores for treatment and social class, and Table 21 presents a summary of the analysis of variance for variability scores.

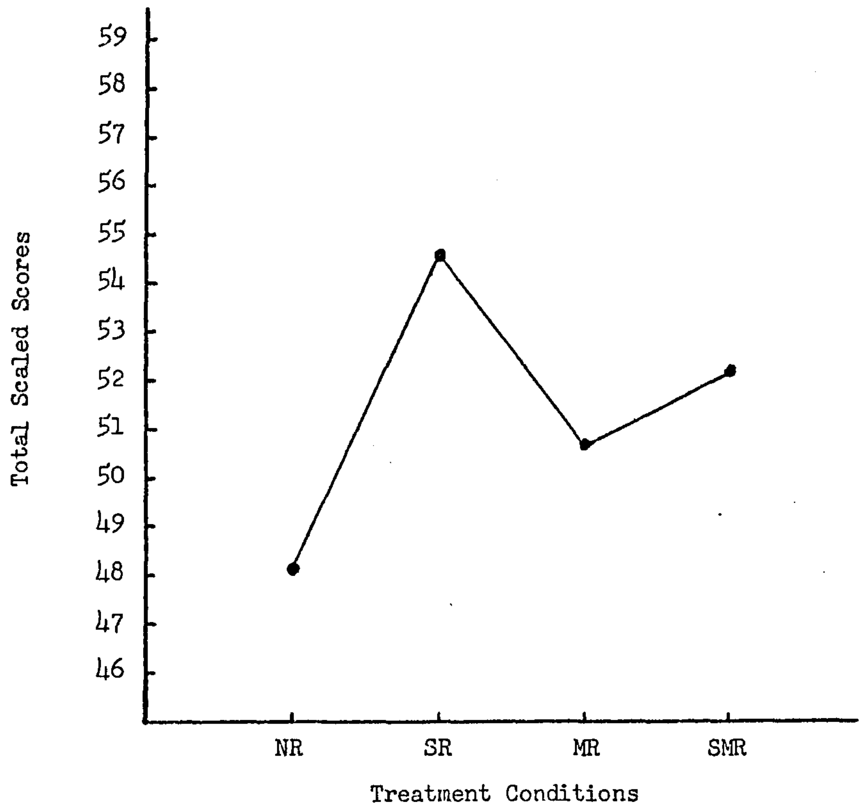

Figure 3. Mean Total Scaled Scores for All Treatment Conditions

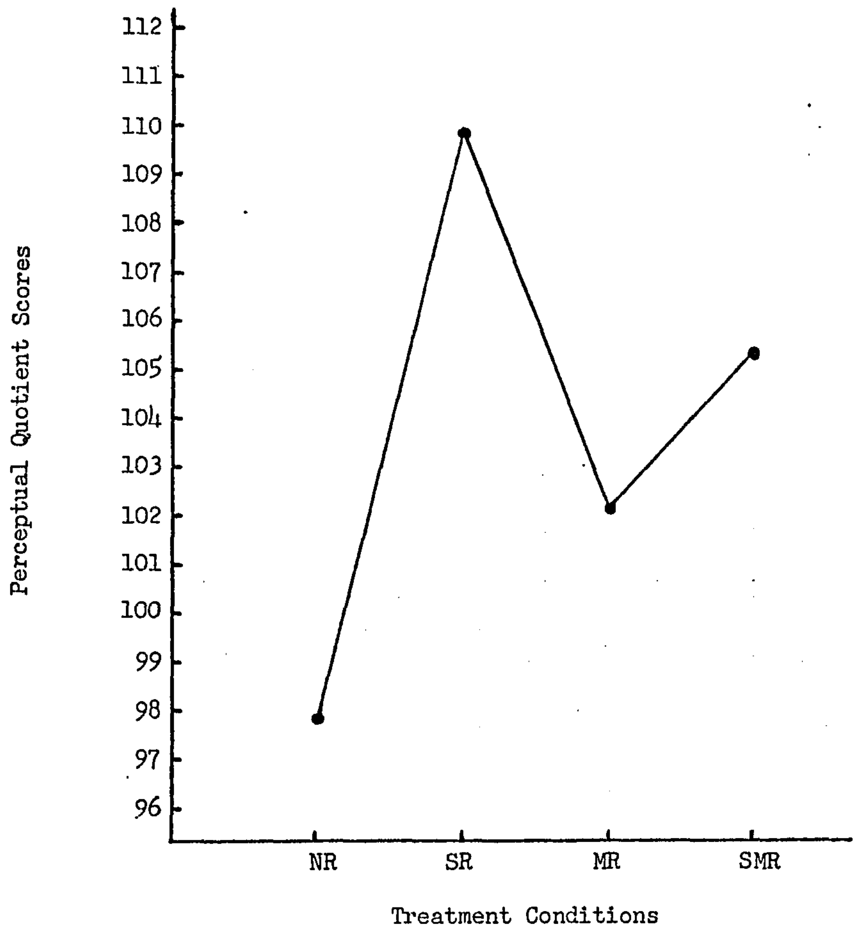

Figure 4. Mean Perceptual Quotient Scores
for All Treatment Conditions

Table 20

Mean DTVP Variability Scores for Treatment and Social Class Conditions

Condition	Score
NR[a]	1.25 (.47)
SR[a]	1.81 (.71)
MR[a]	1.26 (.60)
SMR[a]	1.15 (.45)
Middle-class[b]	1.20 (.59)
Low-class[b]	1.53 (.58)

Note. The numbers in parentheses are standard deviations.

[a] *n* = 20

[b] *n* = 40

Table 21

Analysis of Variance for Variability

of DTVP Subtests

Source	*df*	*SS*	*MS*	*F*
Treatment (A)	3	5.49	1.83	5.23**
Social Class (B)	1	2.13	2.13	6.09*
Sex (C)	1	.001	.001	.001
A X B	3	.40	.13	.37
A X C	3	.34	.11	.31
B X C	1	.47	.47	1.34
A X B X C	3	.03	.01	.03
Residual	64	22.28	.35	

*$p < .05$.

**$p < .01$.

Table 22

Newman-Keuls Analysis of DTVP Variability

for Treatment Mean Differences

Treatment Conditions

	SMR	NR	MR	SR
SMR		.10	.11	.66*
NR			.01	.56*
MR				.55*
SR				

*$p < .01$.

The Newman-Keuls test was used to determine the significant mean differences for the main treatment effect. It was found that the SR condition produced significantly higher ($p < .01$) variability scores over the NR, MR, and SMR conditions. Table 22 presents a summary of the Newman-Keuls analysis. In addition, the lower-socioeconomic class had significantly higher ($p < .05$) variability scores than did the middle-class group.

Split-Half Reliability Under Treatment Conditions

Table 23 presents the Spearman-Brown corrected Pearson product-moment correlation reliability coefficients for DTVP performance under the NR, SR, and combined reinforcement conditions (SR, MR and SMR). In addition, the coefficients in parentheses are those reported by Frostig and her colleagues (Maslow et al., 1964) for the kindergarten-age group. The obtained coefficients under the various treatments are moderate to high. For the reinforcement presentation conditions, the difference in reliability is in a positive direction (except for Subtest III of the combined condition); i.e., higher reliability is obtained under the reinforcement presentation conditions than under the NR condition.

The reliability coefficients reported by Frostig are similar to those obtained under the SR condition and to those obtained under the combined reinforcement presentation. The Frostig reliability coefficients were obtained under normal test administration conditions, i.e., under the condition of noncontingent verbal reinforcement. Statistically significant differences were not found between any of the obtained reliability coefficients in each subtest group and of those coefficients reported by Frostig.

Table 23

Comparison of Split-Half Reliability Coefficients[a] for Treatment Groups and Standardization Sample

Treatment Groups	N	Subtests I	II	III	IV	V	Total
NR	20	.39	.71	.64	.59	.72	.75
SR	20	.57	.85	.73	.80	.78	.86
Combined Reinforced Administration[b]	60	.64	.90	.59	.60	.72	.87
Standard-ization Sample	(364)	(.59)	(.93)	(.67)	(.70)	(.85)	(.89)

[a]Spearman-Brown corrected

[b]Average utilizing Fisher's *z* transformation

CHAPTER V

DISCUSSION

The primary purpose of this study was to investigate the effects of presenting various types of positive reinforcement contingent on correct responding on a perceptual test for young children. More specifically, the treatment conditions of no reinforcement (NR), social reinforcement (SR), material reinforcement (MR), and social plus material reinforcement (SMR) were the primary independent variables. Of a secondary nature, the question of a differential reinforcing effect of a male examiner on the scores of the male and female children was asked. Finally, the kindergarten-age children were dichotomized into middle- and lower-socioeconomic classes in order to determine if social reinforcement was superior to material reinforcement in producing higher DTVP scores for middle-class children and vice-versa for lower-class children.

Interpretation of Results

The results indicated that the hypothesis predicting a main effect for kind of reinforcement presentation on DTVP scores was supported for Subtests III, IV, V, and total test performance. Reinforcement presentation resulted in insignificant score increases on Subtests I and II. For Subtests III, IV, V, and total test performance, the three reinforcement conditions (SR, MR and SMR) produced higher DTVP mean scores than did the control NR condition.

The most plausible explanation for the main treatment effect for Subtests III, IV, and V appears to be the fact that the use of reinforcement had a cumulative effect on the scores of the DTVP. This effect can be visualized by inspecting the graph in Figure 2. During the administration of Subtests I and II the contingent relationship on correct responding was apparently not fully perceived; however, beginning with Subtest III reinforcement procedures apparently took effect. The effects of reinforcement were strong enough on the subtests in order to produce a significant reinforcement effect for total test performance.

A possible alternative explanation for the absence of significant reinforcement effect on Subtests I and II involves the nature of the experimental design used. Had the order of administration of subtests for each subject been randomized to control for sequence effects, it is quite possible that reinforcement would have produced a main treatment effect for all subtests.

A second alternative, although not as plausible, concerns the effect of reinforcement on the nature of the tasks involved in each subtest. Possibly, the tasks requiring eye-hand coordination in Subtest I and recognition of intersecting and hidden geometric forms against complex grounds in Subtest II were not as susceptible to reinforcing conditions as were the tasks of the remaining subtests for kindergarten-age subjects.

In further analysis of the mean differences, the Newman-Keuls test demonstrated the significant superiority of dispensing social reinforcement (SR) contingent on correct responding over the condition of no reinforcement (NR) for Subtest III. For Subtests IV and V the SR condition resulted in significantly higher DTVP scores over the NR, MR, and SMR conditions. Lastly, the Newman-Keuls test indicated significant superiority of the SR condition over the NR and MR conditions for total Scaled scores and of the SR condition over the NR and MR conditions and of the SMR condition over the NR condition for Perceptual Quotient scores. Also, the SMR condition scores for total Scaled scores were close to being significantly higher (at the .05 level) over the NR condition scores. The fact that significance was not achieved in this case was probably due to the difference in intervals between each total Scaled score and each Perceptual Quotient score, i.e., intervals between PQ scores were larger and more varying.

Results demonstrated the relative superiority of social reinforcement in increasing DTVP subtest and total scores and, for all practical purposes, of the social plus material reinforcement in increasing total DTVP performance. A possible explanation for the inability of material reinforcement condition to increase DTVP scores significantly is the fact that the procedure of dispensing the material reinforcement (candy dispensed into a paper cup) after correct responding was distracting to the subject. Norton et al. (1970) made a similar observation when kindergarten-age subjects failed to make gains in a discrimination learning task under a combined verbal approval and material reward condition. Levine and Fasnacht (1974), after reviewing several studies using extrinsic incentives to increase learning, concluded that the presentation of material reinforcement "may shift attention from the [learning] activity to the reinforcer" (p. 818).

The results failed to support the hypothesis predicting a main effect for sex of the subjects. It was demonstrated that DTVP performance of both males and females across treatments was consistent. Therefore, for this study it can be concluded that the male examiner had no differential reinforcing effect as a function of examinee sex, as might have been expected, on DTVP performance. That is, female children did not score higher than males as a result of a male administering the test. This finding, however, does not presume that other male examiners would be unable to exert a reinforcing effect on girls. In addition, the results indicated that kindergarten-age males and females performed similarly on the DTVP instrument. These results were consistent with the findings of Lietz (1972) who found no difference in performance between sexes of kindergarten-age children on another measure of perception, the Purdue Perceptual-Motor Survey.

On Subtest III there was a significant treatment X sex interaction effect. From further analysis using the Newman-Keuls test it was demonstrated that females were significantly more responsive to social reinforcement than were males on this particular subtest. It was also noted that males produced higher mean scores, although not significant, than did females when reinforced with material rewards on Subtest III. In addition, the treatment X sex interaction effect for Subtest V approached the .05 level of significance ($p < .07$). From inspection of the data, females had higher mean scores on Subtest V when given social reinforcement while males obtained higher mean scores under material reinforcement. A recent study (Bergan et al., 1971) found a somewhat similar result involving sex differences in the effects of token and social reinforcement on WISC Block Design performance. However, it was found that fourth-grade girls made significant gains in accuracy under social reinforcement while fourth-grade boys made significant speed gains under social reinforcement. The giving of material reinforcement accounted for no significant Block Design score increases for either sex.

It is not possible to determine from the present data if the social and material reinforcement interaction between boys and girls on Subtests III and V reflects a causal relationship or not. However, since this interaction was not consistent throughout all DTVP subtests, it can be considered relatively inconsequential for the present study.

The final hypotheses which were not supported concerned the differential effectiveness of type of reward as a function of the subject's socioeconomic status. Specifically, it was hypothesized that middle-class subjects would have higher DTVP scores under the SR and SMR conditions while lower-class subjects would perform significantly better under conditions of MR and SMR. However, the findings indicated that both middle- and lower-class children showed the same degree of responsiveness across all DTVP subtests to all types of reinforcement.

The present findings contraindicated the results of other studies (e.g., Higgins & Archer, 1968; Swingle & Coady, 1969; Terrell, et al., 1959) which have found significant interaction effects between type of incentive and social class. There were several reasons which may account for the lack of social class X treatment interaction in the present investigation. The most apparent is the method used to stratify subjects into middle- and lower-social classes. In essence, perhaps the Hollingshead instrument was not sufficiently discriminating, i.e., the subject population of the present investigation was relatively homogeneous. Galdieri et al. (1972) too failed to achieve social class X reinforcement interactions with the Hollingshead instrument.

Other investigations have used different criteria for designating social class or the state of being advantaged as opposed to being disadvantaged. For example, Lietz (1972) defined the term disadvantaged child as being from a family whose income is $3000 or less per year. Terrell and his colleagues (Terrell & Kennedy, 1957; Terrell et al., 1959) designated rural children as being more deprived than urban children, and they have also used a different instrument to define social class position. In any event, the lower-class children of the present study no doubt differed from the lower-class subjects of other studies. Regional differences, e.g., rural southern versus northern urban-ghetto backgrounds, are possible factors accounting for the differences. The children of this study, on the whole, were probably not as deprived as other lower-class groups in those studies finding a significant reinforcement X social class interaction.

However, as Galdieri et al. (1972) concluded, the results are not necessarily in opposition to conclusions of previous studies. Rather, the interaction between type of reward and cultural differences may not be strong enough to concern the psychological examiner in an individual testing situation. From the conflicting research reports, it seems that the relationship of cultural differences and degree of responsiveness to various types of reinforcement procedures remains largely undecided.

In order to determine the effect of treatment, social class, and sex on the variability of DTVP subtest scores, a three-way analysis of variance was conducted on the DTVP subtest standard deviation scores of the subject population. The analysis revealed significant main effects for treatment and social class. In subjecting the treatment mean scores to further analysis of the Newman-Keuls test, it was demonstrated that the social reinforcement condition (SR) had a significantly higher variability as compared to the other treatment conditions. In other words, subjects reinforced by verbal statements responded in a more inconsistent manner than did subjects in the other treatment conditions. For example, some children in the SR group produced higher DTVP scores while others had moderate to lower scores. Therefore, social reinforcement was less stable in its effect, i.e., it was significantly more effective for some subjects than for others. It can thus be reasoned that learning histories of those children in the SR group were probably more varied in their experience with social reinforcement. Possibly some of the children in the SR group had had more experience and contact with people in their environment who regularly dispensed verbal praise; consequently, these children were motivated by social reinforcement. However, the opposite effect was apparently true for other children in the group.

Also, lower-class children demonstrated significantly more inconsistency than middle-class subjects in their DTVP scores. Middle-class children produced more stable scores while lower-class children showed more variability in their perceptual ability. This finding is likely explained by the fact that the lower-class socioeconomic group was a more heterogeneous group in its responsiveness to any type of reinforcement as compared to the middle-class group. That is, some of the children in the lower-class group were more responsive to extrinsic incentives while others exhibited little response. For the present study, social class was not a sufficiently discriminating variable to predict the effect of various kinds of reinforcement on perceptual performance.

Furthermore, it was found that lower-class children had lower, although statistically insignificant, DTVP total Scaled scores than middle-class subjects. This result is consistent with findings of other studies (Lietz, 1972; Norton et al., 1970) which report that lower-class youngsters show significantly poorer performance on perceptual tasks as compared to middle-class youngsters. It is reasonable to speculate that these lower-class children who produced the most deficient DTVP scores have suffered from some of the effects of early sensory deprivation. If early sensory deprivation effects have caused lower-class children to develop an inferior set of perceptual skills as compared to their middle-class counterparts, then techniques to remediate these deficiencies are indicated (Lietz, 1972). Also, Sweet and Ringness (1971) have suggested that standardized testing procedures may be more appropriate for middle-class children for whom the testing procedures are perhaps more challenging and relevant. On the other hand, the lower-class child may respond to testing and to school as well in an altogether different manner, i.e., with less motivation.

The split-half reliability coefficients obtained under the SR and combined reinforcement conditions compared favorably to those reported by Frostig. The use of reinforcement appears to have little appreciable influence on reliability. The implication is that the use of reinforcement, either contingent or noncontingent, does not increase the accuracy of measurement. On the other hand, the use of no reinforcement appears to lower individual subtest and total test reliabilities. For reliability purposes the procedure of offering encouragement and other incentives during DTVP test administration is preferable to withholding reinforcement.

Commenting on DTVP reliability in general, Hammill et al. (1971) stated that a test used as a basis for structuring remedial programs should possess high reliability in order not to misdiagnose or to overlook anyone. Using the traditionally accepted reliability coefficient of .80 as adequate, the DTVP subtests, as a group, do not have adequate content sampling reliability or, for that matter, temporal reliability. Total test reliabilities, however, are acceptable. Therefore, the use of subtest scores for diagnostic purposes should be carried out with caution.

Implications of Results

The overall results of the investigation have educational as well as clinical implications. First of all, these results add to the knowledge that behaviors requiring perceptual abilities can be brought under the effects of reinforcement contingencies and that reinforcement can increase performance on perceptual tasks. Given these conclusions, it can be reasoned that the use of extrinsic incentives could be effective in increasing the learning of perceptual skills by young children. Carrying this notion further, the deliberate application of extrinsic incentives would seem to be indicated in using perceptual training programs, e.g., the Frostig-Horne program. Certainly the Frostig-Horne training program has generated controversy regarding its overall effectiveness in teaching perceptual skills. For example, one evaluation (Wiederholt & Hammill, 1971) of the Frostig-Horne program found evidence relating its effectiveness to the number of worksheets completed by students. Perhaps, the use of extrinsic reinforcement procedures would also increase the program's effectiveness to an even greater degree. This notion needs verification by further research.

Results also demonstrated the superiority of social reinforcement over material reinforcement in increasing DTVP scores. The use of social praise as a motivator certainly has practical and economical advantages over the use of more costly and cumbersome material reinforcers. Social reinforcement is easier to use in both educational and clinical settings.

Recently, the use of material reinforcement in educational settings has been criticized (Levine & Fasnacht, 1974). While material rewards are generally acknowledged as being effective in increasing learning, the long range consequences have been found to decrease interest in the reinforced activity. Levine and Fasnacht posit an attributional explanation for the fact that intrinsic pleasure can be reduced by giving a material reward for an activity.

> If one is doing activity X without a reward, then activity X must be worth doing. If one is getting a reward for activity X, it must not be worth doing without reward. (p. 818)

On the other hand, the use of social reinforcement in educational settings may prove to be less detrimental in its long range effects. Social reinforcers are more likely to occur in the natural environment and, therefore, be more available than material rewards for generalization purposes.

Another implication of this study concerns the attitude, no doubt held by a large segment of the lay population, that test results are definitive and precise measures of behavior. To be sure, these results demonstrate the effects of other variables, i.e., reinforcement, in influencing scores on a perceptual test. Tests should not be considered as the final word but need to be interpreted within a clinical perspective and incorporated with other pertinent data in order to derive the appropriate conclusions.

A final implication concerns the use of perceptual tests as diagnostic instruments. Since the use of extrinsic incentives has been shown to increase perceptual test results of normal subjects, the use of these tests may be of questionable validity as a diagnostic indicator of perceptual deficiencies or of a specific neurological impairment. However, the possibility exists that organically impaired individuals would be influenced by reinforcement proportional to the influence to normal individuals. If this were the case, reinforcement would not necessarily be a confounding variable; however, it would be imperative to know precisely the degree of reinforcement effect and to follow a standardized procedure of dispensing reinforcement in order for perceptual tests to retain diagnostic value. In any event, a need exists for further research in investigating the effects of reinforcement on perceptual test performance of diagnosed organically impaired (brain damaged) individuals.

Summary

The purpose of this study was threefold: (a) to investigate the effects of presenting various reinforcement procedures contingent on correct responses to a test of visual perception, (b) to determine if there is a difference in performance between boys and girls as a possible differential effect of a male examiner, and (c) to determine if a difference exists in responsiveness to the various types of reinforcers as a function of social class.

The subjects were 80 children, ranging in age from 59 to 75 months and equally divided by sex, who attended regular kindergarten classes. The subjects were dichotomized into middle- and lower-socioeconomic classes by utilizing the Hollingshead Two-Factor Index of Social Position. The dependent measure was performance on the Frostig Developmental Test of Visual Perception (DTVP) which consists of five separate subtests measuring different perceptual skills. Groups of 20 randomly selected subjects were randomly assigned to one of four treatment groups: (a) no reinforcement (NR)--subjects were administered the DTVP with no reinforcement presented by the examiner; (b) social reinforcement (SR)--subjects were reinforced by verbal approval statements, e.g., "Good," "Okay," etc., upon making correct DTVP responses; (c) material reinforcement (MR)--subjects were reinforced with "penny" candy upon making correct DTVP responses; and (d) combined social and material reinforcement (SMR)--subjects received both types of reinforcement under the same conditions of the SR and MR groups. Reliability of dispensing treatment and of scoring the dependent measure was assessed by independent judges.

After treatment, the DTVP Subtest, total Scaled, Perceptual Quotient, and variability scores were subjected to a three-way factorial analysis of variance (treatments X social class X sex). Significant differences revealed by the analyses were further analyzed by the Newman-Keuls procedure for post-hoc mean comparisons. Magnitude of significant effects was tested by the Omega Square (W^2) method of correlation. Lastly, in order to assess the effects of the treatment conditions on the reliability of the DTVP, split-half reliability coefficients were computed for each treatment condition.

Results revealed significant main treatment effects for DTVP Subtests III, IV, V, and total test performance. There were no social class or sex effects and only one significant treatment X sex interaction effect for Subtest III. Of the significant main treatment effects, from 6% to 25% of the variance of the DTVP scores was accounted for by the different modes of reinforcement presentation. The Newman-Keuls test demonstrated that social reinforcement produced significantly higher DTVP scores on the subtests and total test. Also, the SMR condition produced significantly higher Perceptual Quotient scores over the NR treatment. Furthermore, results demonstrated significant effects for treatment and social class on the analysis of variance of variability scores. Higher DTVP score variability was found for social reinforcement presentation and for the lower-socioeconomic group of subjects. Although statistically insignificant, higher split-half reliability coefficients were obtained under the reinforcement conditions as compared to the NR treatment.

In conclusion, results indicated the significant superiority of social reinforcement in producing higher DTVP scores of kindergarten-age children. Also, subjects in the social reinforcement and lower-class groups had scores with significantly higher variability. It was also demonstrated that the presentation of reinforcement in general was responsible for higher DTVP split-half reliability coefficients. However, it was determined that the use of a male examiner produced no significant differences in DTVP scores of boys or girls and that social class was not a significant variable in influencing the subject's degree of responsiveness to the various types of reinforcers.

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Appendix A

Explanatory Letter to Parents

Concerning the Experiment

Dear Kindergarten Parent:

Presently, I am engaged in a psychological research study involving the testing of kindergarten-age children. The study concerns how visual perception (i.e., how children perceive objects and forms, how well vision is coordinated with fine motor skills, etc.) as measured by a standard perceptual test is influenced by giving to the child verbal praise and tangible rewards for correct responses. Knowledge gained from the results of such a study will help us to determine the value of using perceptual tests in diagnosing learning problems and to determine what effect a test-giver has on the child's test performance.

The school has agreed to my testing some of the kindergarten children providing that parental permission is secured. Participation of your child will be strictly on a volunteer basis.

Testing will take place during the last week of the month. Results of testing will be given to the school for educational purposes.

If you desire to have your child take part in this study please complete the enclosed, self-addressed post card and return it to me as soon as possible. If you have any questions, please do not hesitate to call me at (telephone number).

Your cooperation will be appreciated.

Sincerely,

Robert G. Ferree, III

Enclosure

Appendix B

Parental Permission Form

PLEASE COMPLETE ALL INFORMATION:

My child, ____________________________, has permission to participate in the visual perception testing.

Child's age __________; Birthdate ____________________________________
yr. mo. day

Occupation of head
of household ____

Educational level of head of household (check one):

Grade 1-7 ______; Grade 8-11 _______; H. S. Graduate _______;

1+ yr. college _____; College degree _____; Graduate degree _____.

____
Signature of parent

Appendix C

Subjective Appraisal of Reliability of Adherence to the Standardized Instructions of the DTVP and of Adherence to the Procedures of the Treatment Conditions

Judge: 1_____, 2_____. Treatment Condition: NR____, SR____,
MR____, SMR____.

I. Adherence to the standardized instructions of administering the Frostig DTVP:

	Observation #1	Observation #2	
a.	__________	__________	Poor (showed little regard for following the instructions for administration).
b.	__________	__________	Fair (followed instructions for administration for approximately 50 per cent of the observed time).
c.	__________	__________	Good (approximately 75 per cent adherence to the manual of instructions).
d.	__________	__________	Excellent (approximately 95 per cent or more adherence to the manual of instructions).

II. Adherence to stated procedures of the treatment conditions:

a.	__________	__________	Poor (conditions of treatment followed for approximately 50 per cent of the observed time).
b.	__________	__________	Good (conditions of treatment followed for approximately 75 per cent of the observed time).
c.	__________	__________	Excellent (conditions of treatment followed for approximately 95 per cent or more of the observed time).

Appendix D

DTVP Split Half Reliability Worksheet

Name______________ Treatment Group__________ Sex________ SES__________

Subtest	Group I	Group II
I	1	2
	3	10
	12	6
	4	7
	13	8
	11	14
	5	15
	16______	9______
II	1	2
	4	3
	6	5
	7	10
	9	8
	13	18
	14	11
	12	16
	17	19
	15______	20______
III, Positive	2	32-18
	5	14
	16-2	1
	31-17	28-14
	19-5	4
	11	3
	26-12	10
	23-9	13

++

Subtest	Group I	Group II
III, Negative	21-7 8 7 25-11 17-3 18-4 20-6	30-16 27-13 9 6 12 22-8 24-10
IV	1 2 5 8	3 4 6 7
V	4 2 5	3 1 6