RECEPTOR DOMINANCE TRAINING EFFECTS IN AUTISTIC BOYS

by Michael Elterman

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CURRICULUM STUDIORUM

Michael Elterman was born in Cape Town, South Africa, in 1953. He received the Bachelor of Social Science Honours degree in 1975 from the University of Cape Town.

ABSTRACT

Based primarily upon observation and also various research studies, it has been proposed that autistic children manifest a contact receptor dominance. Further, it is proposed that the abnormal response to sensory stimuli frequently observed in autistic children represents an arrest in perceptual development. Following the sequence outlined by Jones and Hart (1968) where they present the idea that the normal child develops from near- through mid- to far-space, an attempt was made to help the autistic child move beyond near-space employing sensory discrimination training. To this purpose, four autistic and four normal boys were matched according to their mean ages. These were later further divided into three groups: two autistic treated, two autistic control, and four normal control subjects. The aim of the study was to: (a) test whether there was contact receptor dominance (touch) in the autistic boys and distance receptor dominance (vision and audition) in the normal subjects; (b) whether training of the autistic experimental group could facilitate a shift in receptor dominance towards that shown by the normal controls. In the 5-month program, each of the two treated boys received 50 hours of training aimed towards development from contact to distance receptor usage. On both the pre- and posttests for all three groups an 18 trial training period preceded

the 36 trials of bimodal sensory stimulation where two stimuli were presented simultaneously, left and right. Subjects were required to indicate from which side of the apparatus they perceived the auditory, visual, or tactile stimulus. Results of the study showed a contact receptor dominance in the autistic group and a distance receptor dominance in the normal group. After training, the results indicated a substantial change in the receptor dominance of the treated autistic boys. This change was: (a) consistent over both subjects, (b) greater than proportional fluctuations in both controls, and (c) in the hypothesized direction. It was concluded that the treated autistic boys showed less contact receptor dominance after training.

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CHAPTER I

INTRODUCTION AND REVIEW OF THE LITERATURE

The Differential Diagnosis of Infantile Autism

In 1906, DeSanctis attempted to provide the structure for child psychoses that Kraepelin had done earlier for adults in his formulations of dementia praecox (1893). He gathered a number of cases which had in common the symptoms of lack of affect, stereotypy, and catatonia, and grouped them under the name "dementia praecocissima." Despert (1965), in fact, believes that it was with this description by DeSanctis, that disorders specific to childhood were first reported. Earlier cases by Esquirol in France (1830) and Maudsley in England (1880) are recorded, but were regarded by them as early manifestations of adult disorders. Bleuler, in 1911, renamed dementia praecox "the group of schizophrenias" and in this way he shifted the emphasis from dementia, the outcome of the process, to the morbid process itself. He also, at the same time, introduced the concept of "autism" to describe a primary manifestation of schizophrenia. This denoted a withdrawal from reality into a fantasy world of archaic imagery.

It took as late as 1933 for Potter to formulate a set of criteria specifically applicable to children.

He wrote that to justify the diagnosis of childhood schizophrenia, there must be: (a) a generalized retraction of interest from the environment, (b) disturbances of thought and language, (c) a defect of emotional rapport, and (d) an increase or decrease in motility often manifested as bizarre behaviour. By the end of the 1930's, childhood schizophrenia became widely reported in the literature as a syndrome. It was out of this broader diagnostic category that Kanner in 1943 reported the syndrome of "infantile autism" as an "inborn disturbance of affective contact" (p. 250). In his now classic report, Kanner introduced autism as a distinct syndrome on the basis of 11 case histories, differentiating it from childhood schizophrenia on the one hand, and mental retardation on the other. The outstanding pathognomic feature was defined as "the children's inability to relate themselves in the ordinary way to people and situations from the beginning of life" (1943, p. 218). In making the important distinction between autism and childhood schizophrenia he emphasized that "it is not a 'withdrawal' from formerly existing participation but . . . from the start, an extreme autistic aloneness" (p. 220). The common features in Kanner's initial sample may be summarized as follows:

(a) From the very beginning, feeding problems were encountered.

(b) Intruding loud noises and moving objects were reacted to with horror.

(c) Actions were frequently monotonously repetitious with a resulting limitation in spontaneous activity.

(d) Although 8 of the 11 acquired the ability to speak, in no case did vocalization serve for communication. Sentences were echolalic and personal pronouns, repeated just as heard.

(e) In contrast to the children's inability to relate to people, they established good relations to objects.

(f) Their physiognomies were intelligent and most appeared to be physically normal.

In 1956 there appeared a follow-up summary publication in the development of Kanner's syndrome (Eisenberg & Kanner, 1956). By that time 120 cases had been observed and two broad conclusions were drawn: (1) that the extreme aloneness and preoccupation with preservation of sameness is manifest within the first two years of life; and (2) that the early onset and clinical cause distinguish it from childhood schizophrenia "to which it is probably generically related" (p. 585). The age of onset is a contentious, but important point and it has been suggested by Rimland (1964) that the disorder may begin at any time before about 30 months of age.

The problem of differential diagnosis is particularly problematic as there are various features in common between autism and childhood schizophrenia. This is further complicated because other disorders such as deafness, aphasia, epilepsy, and hyperkinesis may produce similar symptomatic effects. As a consequence of this general failure to provide explicit and unambiguous diagnostic criteria, the British working party under Creak (1961) set out to accomplish this for what she termed "the schizophrenic syndrome of childhood." Although there have been various attempts at this task (Asperger, 1968; Rimland, 1964), the nine criteria Creak proposed are those most widely employed by psychiatrists as guidelines in diagnosing autism after the fundamental condition of age of onset is met (Gillies, 1965; Mittler, Gillies & Jukes, 1966; Wing, 1966). A combination of these diagnostic criteria are found in both autism and childhood schizophrenia. Bender (1967) suggests that together with early onset, they encompass the different symptom emphases in which autism may become manifest. These nine points will be outlined briefly.

1. Gross and sustained impairment of emotional relationships. This includes aloofness and "empty clinging," as well as abnormal behaviour towards other people as persons, such as using them or parts of them impersonally.

2. The child shows apparent unawareness of his own identity to a degree inappropriate to his age. This may be manifested in behaviour such as posturing or exploration of his own body parts. Repeated self-directed aggression may be another aspect of his lack of integration.

3. Pathological preoccupation with particular objects or certain characteristics of them, without regard for their accepted functions.

4. Sustained resistance to change in the environment and a desire to restore and maintain sameness. Behaviour often appears to aim at producing a state of perceptual monotony.

5. Abnormal perceptual experience as implied by excessive, diminished, or unpredictable response to sensory stimuli.

6. Acute, excessive, and apparently illogical anxiety is manifested. This tends to be precipitated by change, whether in material environment or routine. Commonplace objects or phenomena come to possess terrifying qualities, whereas fear may be lacking in objectively dangerous situations. Elevators, vacuum cleaners, and doorbells, for example, may bring on a major panic, but the child himself can happily make as great a noise as any that he dreads.

7. Speech may never be acquired, or may fail to develop beyond a level appropriate to an earlier stage. There may be confusion of personal pronouns, echolalia, or other mannerisms of use and diction.

8. Distortion in motility patterns--for example, (a) excess (as in hyperkinesis), (b) immobility (as in

catatonia), and (c) bizarre postures or ritualistic mannerisms (e.g., rocking, whirling or spinning himself or objects.

9. A background of serious retardation, in which islets of normal, near-normal, or exceptional intellectual function may appear.

Despite the fact that these diagnostic criteria encompass both autism and childhood schizoprhenia, it is possible to delineate a "pure form" for each of the syndromes and also "mixed forms" where there is a definite overlap. Rimland (1964) and Tustin (1972) cite many points of difference between autism and childhood schizophrenia in their pure forms. In the onset of childhood schizophrenia, there are usually at least three to four years before the complete schizophrenic symptomatology manifests itself (Rimland, 1964; Tustin, 1972). Alternatively, the autistic child, as noted before, exhibits extreme withdrawal from a much earlier age. A further difference lies in the sex distribution: the 4, 5 males to 1 female in autism is a similar incidence to that found in congenital disorders of development, whereas the 2 males per female ratio for childhood schizophrenics is closer to that found for adult schizophrenics (Creak & Ini, 1960; Eisenberg & Kanner, 1956). Where the autistic child has virtually no fantasy play, the schizophrenic child shows confused and primitive play (Kolvin, 1971). There is also a significant difference in the incidence of psychopathology in the families of autistic and schizophrenic children. Mayer-Gross et al. (1969) claim that mental disorder does not occur with any more than random frequency in the parents of autistic children and adult schizophrenic patients do not have a history of autism in childhood. Only one of the first 200 parents seen by Eisenberg and Kanner (1956) had experienced a psychotic disorder. From the work of Kallman and Roth (1956) it emerged that, in its genetical relationship, childhood schizophrenia behaves in much the same way as in adults. The incidence of schizophrenic psychosis in the parents and siblings was at a level comparable to Kallman's (1950) findings with adult schizophrenia. The concordance rate, Kallman found, in the 17 monozygotic twins was 88%, and 23% in the 35 dizygotic twins. Another difference noted by Bender (1965) lies in the observation that autistic children tend to avoid contact with others and often avert the eyes from looking at people. On the other hand, the child schizophrenic's contact is pathologically invasive and seems to look "through" rather than "at" others (Tustin, 1972). Finally, where the autist manifests "inhibition of thinking" and is often fascinated by mechanical objects, the childhood schizophrenic shows "confusion of thinking" and less idiosyncratic obsession with objects (Tustin, 1972).

In line with Kanner's original formulation, Kugelmass (1970) and Churchill (1971) suggest that they would diagnose a child as autistic if he presents emotional impairment, resistance to change, and abnormal relation to objects. These correspond to the first, second, and eighth of Creak's (1961) diagnostic criteria, respectively. Certainly, the early withdrawl of the child is by far the most important feature. The parents of these children often describe them in infancy as being "cold," "as in a shell," and "happiest when left alone" (Wing, 1966). During the first few months of life, no abnormality is characteristically detected, but this is perhaps more a function of parental inability to perceive any deviance from the norm. On the other hand, the child may, during the first three months, pass through a stage of "normal autism" as Mahler (1971) suggests. During this time, according to her, the autistic behaviour is age appropriate, but where the normal child passes through this, the autist is unable to proceed.

At a later time, there are likely to be difficulties in establishing normal routines of eating, sleeping, and elimination. The earliest typical symptom to appear at about the fourth month is that the infant does not raise its arms in anticipation when about to be lifted up. According to Gesell (1948), the normal child at about four months makes an anticipatory motor adjustment by facial tension and shrugging motion of the shoulders. It is significant that all the mothers in Kanner's (1943) sample recalled their children's failure to assume at any stage an anticipatory posture preparatory to being picked up. Also, the normal infant learns during the first few months to adjust his body to the posture of the adult holding him. The autistic children were never able to do so.

The cause of autism is not known. This has led to a deluge of theorizing from nearly every approach in psychology. The problem has existed as a minor nature-nurture controversy with proponents seeking either purely psychogenic, organic, or genetic causes, or a variety of multi-etiological origins. An important consideration is perhaps that, irrespective of the intensity of a cause, the effects depend upon thresholds and functional compensation (Kugelmass, 1970). For example, in many families, disturbances of mothering are far grosser than that to which autism is attributed by the psychogenic theorists, yet the children show relatively minor effects. The theories proposed are not necessarily mutually exclusive, but have focused on different areas of malfunctioning. O'Gorman (1967), Chapman (1957), and Rosenthal (1970) support a genetic view, and Simon and Gillies (1964 note biochemical differences. Bettelheim (1967) and Ruttenberg (1971) take a psychoanalytic approach with special emphasis on maternal deprivation, and Ferster and DeMeyer (1961, 1962) proposed a learning etiology.

The approach that shall be examined more closely later, and which pertains particularly to the present study, is that of a perceptual defect in autism (Rimland, 1974; Schopler, 1965). This aspect of autistic behaviour is described in two of Creak's diagnostic criteria: abnormal response to sensory stimuli, and the desire for perceptual constancy. Bergman and Escalona (1949) were the first to document unusual sensitivities and perceptual distortions in schizophrenic children and proposed that ordinary stimuli might be overwhelming to a deficient stimulus barrier. This idea gained some support from Goldfarb's (1956) comprehensive study of schizophrenic children. Among his many findings he placed the perceptual defect in a central position. More specifically, he proposed that there is an alteration in the normal hierarchy of receptor dominances: "A diminished use of the distance receptors, sight and hearing . . . and a contact receptor, particularly touch, preference" (pp. 643-644). Some years later, Schopler (1965) applied this specifically to autism and he proposed that it is a defect in perceptual activity which underlies the syndrome. Although many writers have theorized concerning the role of perceptual activity in autism (Delacato, 1974; Ornitz & Ritvo, 1968; Rimland, 1964), more reports are observational rather than experimental in nature.

The present study will approach autism from a perceptual perspective, specifically viewing the disorder as a perceptual defect. This manifests as a contact receptor dominance. In the next sections of this chapter, the concepts of contact and distance receptor functioning will be introduced and discussed in the context of perceptual development. Also to be presented is the proposed perceptual defect and the symptomatic effects of this in autism where it is manifest as a contact receptor dominance. This dominant mode of functioning is a central concept in this study and will be discussed in the light of the research evidence available.

Distance and Contact Receptor Activity

In his classical work, "The Integrative Action of the Nervous System," Sherrington (1906) provided a simple yet brilliant model within which to order receptor experience. He described the division between "distance" and "contact" receptors where the former react to objects at a distance through vision and audition, and the latter, to objects in close proximity or in contact with the organism via gustation, olfaction, and tactuality. There is a great difference in the amount and type of information that the two receptor systems can process.

The importance of the distance receptors in phylogenetic development has been emphasized by Rado (1954) and Hall (1966, 1976), who suggest that they provide the organism with the increased survival potential of being able to survey the environmental space. The ability on the part of an organism to react to an object when still distant from it allows an interval for preparatory reactive steps which can influence the success to obtain actual contact or to avoid contact with the object. Karamyan (1968) points out that a major change in both structure and function of the brain occurred with the development of the arboreal life which demands keen vision and decreases dependence on smell. At that time, he continues, the distance receptors developed, changing a predominantly brain-stem integration to a diencephalic cortical integration. Rado (1954) and Hall (1966, 1976) propose further that it is this development which has produced the growth of the neocortex in higher forms of mammals. More abstract mental functioning appears to be dependent primarily upon the operation of the distance receptors. The contact receptors, on the other hand, are tied to the older, more primitive centres and pushes man in the direction of the concrete present (Hall, 1976).

The concept of a hierarchical structure of sensory systems is evident in the developmental process in normal children. This concept has been used by Renshaw (1930), Zaporzhets (1961), and Hall (1976), among others. Schachtel (1965) proposes that interoceptive and visceral sensations are dominant in the neonate; this dominance is gradually superceded first by tactile and kinesthetic, and then by the auditory and visual sensory systems. A parallel process is the gradual establishment of the equivalence and integration of different sensory information, so that stimuli to one sense can be readily recognized and interpreted by another. A notion that is widely held is that each developmental stage is in some way dependent upon a particular level of maturation of previous stages. It is not assumed, however, that the child recapitulates his own evolutionary past. This concept oversimplifies an extremely complicated arrangement. The reason why the idea of the evolution of the brain does have meaning is that, at every stage of evolution, the brain retained some of its older organization and incorporated it into the reorganized state, just as this occurs in the developing child (Ayres, 1977). Therefore, when the development of the brain has deviated from the norm, the behaviour which results is frequently reminiscent of lower levels of the phyletic scale, according to Werner (1948). For a long time, the brain-stem, including its upper-end, the thalamus, served as the highest centre of neural processing, integrating sensori-motor functioning in an efficient although elementary mastery of the perceptual-motor world. Vision and audition, Lassek (1957) writes, develop later than, and are somewhat dependent upon, the earlier modalities.

According to the work of Jones and Hart (1968), the normal child's receptor development should proceed as: Gustation-Olfaction-Tactuality-Kinesthesia-Audition-Vision (G-O-T-K-A-V). The gustatory and olfactory stages revolve around the mouth and are closely tied functionally. When the child enters the kinesthetic and tactual stages, he must develop the muscular activity involved in normal coordination. He begins to move around on his own and develops some idea of how to cope with space and gravity. In the tactile phase, the child organizes the use of his skin surface to recognize differences in temperature, texture, and pressure (Delacato, 1974). During this time he begins to identify, localize, and imitate the sounds around him. As this focus on audition continues, he finds that sounds can be used to refer to the gustatory, olfactory, tactual, and motor experiences he has had. Although vision is associated with all these learning experiences and has been developed in conjunction with all the other ways of functioning, "true" vision--to "know" through seeing--is the most complex ability of all (Hall, 1966; Jones & Hart, 1965; Zinchenko & Lomov, 1960).

Since it is a way of perceiving something without having to touch, smell, or taste it, a child must have experienced these various sensations many times before and organized his experiences before he can understand the world by merely seeing it. For example, if he has already found out that balls are round, soft, or hard, and can bounce, then a ball on a shelf can mean all these things to him. On the other hand, if he has not yet had experiences with a ball nor organized these experiences, then the sight of a ball is meaningless. When a child cannot know by merely seeing an object, he must use simpler and more direct modes of experiencing; that is, those of the contact receptors. To do this, he must be near to it. In a similar way, perception of sensations depend to a large extent on intersensory integration, so that the message that is conveyed is congruent and reinforced (Ayre, 1977; Jones & Hart, 1968). For example, the normal child learns that the sight of steam rising from a cup of brown liquid, together with the sensation of heat from the cup, a particular odour and taste, all mean that the content is hot chocolate. The child who cannot differentiate these sensations is not able to reinforce the message of one sense with that of another.

Receptor Dominance

The concept of "receptor dominance," which differs between and within species during the course of development, was first proposed by Abbott (1882) in the course of his animal research. Reference to the fundamental importance of the receptor dominance of tactility in infants may be found in Freud (1949) who wrote that at the beginning of life, the entire skin surface is erotogenic. Schopler (1965) found that visual preference increased between ages 3 to 6 years when both groups of normal children were offered a choice of visual and tactile objects presented at the same time. A relatively greater contact receptor use was found in the younger children, and relatively greater use of the distance receptors in the older children. Schopler made the inference that "as the child increasingly recognizes objects by their form and function, distance receptor exploration can more easily replace near-receptor exploration" (p. 330). A similar view of development is taken by Zaporzhets (1961) who quotes experimental results in which 3-year-old normal children score higher in the discrimination of shapes when allowed to handle them, while visual exploration was used more often by 6-year-olds. The findings of Tarakanov (1960) support this. He presented normal children from age 3 to 7 with geometric figures both visually and tactually and asked for recall in either modality. He reports that most efficient coordination between vision and touch did not appear until age 4 and 5 years. The hypothesis of preference for contact receptors in the young was criticized by Walters and Parke (1965) who argue that vision and audition are present from birth and that discrimination must develop for the process of social responsiveness to occur. The point that they seem to overlook is that, because these two modalities do function and play a role at this early stage, this says nothing of the "relative" dominance or preference between contact and distance receptors. It is clear from the studies of Fantz (1961), Kagan and Lewis (1964), and Gibson and Walk (1960) that the visual system has considerable power of discrimination prior to 6 months of age. Nonetheless, Ellingson (1960), in a well-controlled study, found that in normal neonates, tactile stimuli are most effective in eliciting nonspecific cortical E.E.G. responses, auditory stimuli next, and visual stimuli least effective. Gewirtz (1961) found that the more effective reinforcers in infancy involve skin contact and warmth. The crux of this is that, although there is evidence (Papousek, 1967) that development of visual discrimination is present from early infancy, tactile stimuli may be more arousing in infancy than the distance receptors. Hermelin and O'Connor (1970) concur with this point and propose that "arousal value and discrimination ability are not necessarily correlated" (p. 40).

Goldfarb (1956, 1961) used Sherrington's division when looking at the symptoms of childhood schizophrenia with its deviant pattern of receptor activity. From direct observation, he found an alteration in receptor functioning involving a contact receptor dominance and diminished use of the distance receptors. He also found, however, in most cases no evidence of any defect in visual or auditory acuity. Rather, the behaviour suggested the presence of distance receptor avoidance or inattention as well as a contact receptor preference. The dominance of the contact receptors was most evident among the schizophrenic children with the lowest level of ego-organization, but was also detected in the more highly integrated children. Schopler, in 1965, noted the similarity between schizophrenic and autistic children with regard to receptor dominance. Since that time, a fair amount of evidence for a contact receptor dominance in autism has been presented by Rimland (1964), Wing (1966), and Hermelin and O'Connor (1970). Schopler (1966) compared 30 autistic, 90 normal, and 15 subnormal children in a free-play situation, on the basis of their preference for various objects and toys in exploration. Some of these were colour slides, a vibrating surface, a kaleidoscope, plasticine, and blocks which were coloured differently as against blocks with different surface textures. He found that for normals, visual inspection increased with age, and the autists generally preferred to explore tactually. Hutt and Ounsted (1966) and Hermelin and O'Connor (1965) studied the relative visual inspection responses of normal and autistic children to different face-masks mounted in an experimental room. They found that the autistic children spent a far higher proportion of the total time recorded looking elsewhere as compared with the controls. When they did look at the faces, it was with short, darting glances. An important experiment by Hermelin and O'Connor (1970) used a tracking procedure with and without visual cues to investigate to what extent autistic children would use information from vision. The task consisted of guiding a metal stylus inside a perspex groove. This was carried out under two conditions, one in which the child had a view of the track, and another where an apron, tied behind his neck also covered the display. The difference between these two conditions was far greater for the normal than for the autistic children. Normal children performed the tracking task faster and more accurately when they could see what they were doing than when they could not. The autistic children scored as well as the normals without visual cues, but became significantly slower, in relation to the normals, when the track was visible. With regard to audition, Braunstein (1958) illustrated how normal children alter their speech while listening to delayed auditory feedback. The speech in autistic children, however, remained unchanged under the same conditions and with no auditory defect in acuity present they showed severe inattention.

The role of the distance receptors, suggest Walters and Parke (1964), is of primary importance in the development of social responsiveness in infancy. Fantz (1961) found that the infant before 6 months of age responds to the human face and voice above all other stimuli. On the basis of observation, Delacato (1974) proposed that in children with a contact receptor dominance there is also likely to exist a lack of emotional and social responsiveness. It is not uncommon in their interaction with others to observe them merely transacting to receive the comfort of body warmth. The autistic child does not develop this social responsiveness in infancy which is an important aspect of his emotional isolation.

The observer of an autistic child finds himself unable to achieve visual contact with him. The child seems to avoid direct visual contact by averting his gaze and is given to "eye-roving," rather than fixating or "pursuing." He may constantly "hum," hyperventilate, or make the sound "aah-aah" and frequently covers his ears to block out external noise. In this way he maintains perceptual constancy and prevents complex external stimuli from overwhelming him. A very common mode of sensory activity is smelling and sniffing. When the autistic child enters an unfamiliar room, he may attempt to learn more about the objects therein by moving closer and smelling them. The object being explored is brought closer to the nose, whether it is food, inedible object, or own body parts. The area within the mouth, richly endowed with contact receptors, is an important source of sensory stimulation and a source of information about small objects and small segments of anatomy. Exaggerated hand touching and manipulation of objects are commonly reported and many parents complain that their autistic child "cannot keep their hands of their surroundings" (Kugelmass, 1970). To the observer, the child may appear to use "inappropriate" senses when faced with various objects and situations. This may partly indicate one of Creak's diagnostic points, that of preoccupation with objects without regard for their accepted function.

The autist's indifference to his mother and failure to assume any posture of anticipation before being picked up is well known (Schopler, 1965). Kanner, in fact, noted this as early as 1943 in the first identified group and proposed it then as an aid to diagnosis. The difficulty in anticipating events may represent a lack in the integration of sensory stimuli or, as Rimland (1964) proposes, a deficiency in relating novel incoming stimuli with past experience. (Of this latter view, more will be said later.) Some important experimental support comes from Walter (1971). He developed an E.E.G. technique that reveals an expectancy wave in the frontal lobes following a warning stimulus to perform a given action. Walter observed that the contingent negative variation (C.N.V.) in E.E.G. studies of normal and autistic children is the most accurate measure of cerebral maturity. He writes that autistic children who frequently show absent C.N.V.'s respond irregularly and with delays indicating lack of anticipating. The autist's use of his distance receptors is a defective disorganization in functioning rather than a mere regression to infantile levels of receptor activity. The autistic infant lacks patterns of play and, at 10 months, he does not play the universal game of "peek-a-boo" (Delacato, 1974). When there is a failure to reach a perceptual or cognitive representation of sensori-motor coordinations, the child is "arrested" developmentally and inclined towards repetitive behaviour. Prolonged repetition, according to Delacato (1974) and Hermelin and O'Connor (1970), is consistent with a failure of transition from contact to distance receptors.

Sensory Integration and Arousal

Based upon the observations and supporting experimentation of receptor dominance, various neurophysiological hypotheses have been proposed concerning the etiology of autism. Schopler (1965), Ornitz and Ritvo (1969), and Hutt et al. (1965) all allude to a perceptual defect or problem in intermodality integration. Although they may each focus on different aspects of behaviour or draw different inferences from them, they have in common some implication of the child's arousal level as the sole or part source of pathology.

If all available sensory stimuli were allowed to bombard the higher sensory areas, the individual would be rendered ineffective. It is the task of subcortical structures to orient the organism and to filter a vast amount of sensory input. The process of integration depends upon selective facilitation and inhibition at convergent points in the nervous system. A great deal of this convergence occurs at brain-stem level.

The "reticular activating system" (R.A.S.), as it was first described by Moruzzi and Magoun (1949), receives input from all sensory modalities. French et al. (1955) found that there exists an interplay between the neocortex and the brain-stem with the descending influence converging with ascending activity. According to Ayres (1977), if those reticular structures of the brain-stem specialized in depressing neural activity are damaged, a fundamental disorganization of input results. Although integrative activities occur at many levels, those that are concerned with sensori-motor integration are of particular significance to autism. The neocortex evolved historically out of the rhinencephalon which, in the early vertebrates, was critical for organizing sensory information (Karamyan, 1968). Those functions, although greatly modified by the influence of the neocortex, still operate in man today.

As described by Magoun (1961), one of the primary roles of the R.A.S. is its capacity to promote general arousal. This function is widely accepted (Berlyne, 1960; Lynn, 1966). In addition to the degree of alertness, it also has an attentional role in that it influences which aspect of a stimulus field will be reacted to. Hernandez-Peon (1956, 1961) demonstrated that stimulation of different points in the R.A.S. selectively blocks activity in different sensory pathways. Different arousal levels have, in fact, been shown for different stimulus modalities by Bernhaut, Gellhorn and Rasmussen (1953). Attention to information from one channel may inhibit potentials in another modality. Also, insufficiently inhibited sensory stimuli of one modality, due to a defect, may interfere with learning in another modality (Schwartz & Shagass, 1963). Research into the reticular formation has stimulated various theorists in the field of autism to implicate this system as its functioning provides a heuristic basis for much of the observable behaviour seen in autism.

Rimland (1964) proposes that the autistic syndrome represents an impairment in the ability to relate sensory input to memory content instilled by previous experience.

This amount to an impairment of formation and retrieval of information. He goes further to propose that a lesion in the reticular formation produces a functional deprivation of organized sensory input to the cortex. In addition to this proposed defect, Rimland (1964) suggests that there exists in the autistic child a constitutional vulnerability to various noxia during pregnancy and delivery. Hebb (1955) has suggested that with a defect in the arousal system, the impulses arrived at the sensory cortex, but terminate there. As the remainder of the cortex is not affected, learned stimulus-response relations are lost. Such defective arousal mechanisms are perhaps consistent with the autistic child's feats of specific memory which tend not to elaborate with learning.

From a similar perspective to that taken by Rimland, Schopler (1965) proposes that the autistic child's contact receptor functioning represents a "sensory deprivation." He suggests two etiological preconditions for the syndrome:

> An infant with a neurophysiological (reticular) defect, involving low sending power or arousal potential, coupled with a mother who does not compensate for this deficiency with contact receptor stimulation during the first year (p. 328).

The critical role of sensory input has been best illustrated through studies of sensory deprivation which, in humans, results in emotional, cognitive, and behavioural deterioration (Levine & Alpert, 1959; Melzack, 1962). In a particularly interesting study, Zubek and Flye (1964) found that when normal subjects were deprived of visual stimulation for a week they developed increased tactile sensitivity. This effect remained for some days before a normal threshold returned. A now classic investigation of sensory deprivation from early in life was carried out by Riesen (1961b) with cats and primates. One particularly interesting finding occurred when the animals were released. They manifested signs of being literally "overcome" by a normal amount of sensation and responded with violent "emotional storms" and arousal equilibrating behaviour. In the autistic child, according to Schopler (1965), the stimuli are available, but there is an inadequate processing of them. Delacato (1974) writes that neurological growth can be arrested through a drastic reduction in sensory input; it can be slowed by diminished input. Casler (1961) supports this formulation and writes that the autistic child suffers from a lack of "mothering," but only in the sense that the child is unable to receive the tactile-nurturance available. One may see how the psychoanalytic hypothesis of maternal deprivation ties into this. Rather than being a primary cause of the condition, the maternal "coldness" and "aloofness" cited by Eisenberg and Kanner (1965) may be reactive to the child's lack of social responsiveness.

Hutt, Lee, and Ounsted (1965) suggest that the autistic child is in a chronic state of hyperarousal. This, they conclude, may be why the child attempts to maintain sameness. Stereotyped, autistic behaviour increases with the complexity of the environment, but is minimal when the child is by himself in an empty room, according to Kugelmass (1970). Hutt et al. (1965) also found an increased synchronization of the E.E.G. in autistic children placed in an empty room. Hence, they conclude, stereotypical behaviours tend to serve to prevent the level of arousal exceeding critical limits by blocking further novel sensory input. It has been demonstrated by Berkson (1965) that a prolonged state of high arousal frequently leads to withdrawl and stereotyped behaviour in cats and primates.

Ornitz and Ritvo (1968) and Delacato (1974) believe that there exists not one chronic level of arousal, but rather two--hyperexcitation and hypoexcitation. Both agree that either phase may dominate in one child, or that there may exist phases of random sensory overloading and underloading in the same individual. Delacato (1974) follows in the direction taken by Hutt et al. (1968) to the extent that the symptomatic behaviour is an attempt at compensation or, more specifically, an arousal-equilibrating act. In the state when the threshold is low, the child is literally "bombarded" with stimulation. The behavioural withdrawal and stereotypical behaviour are seen by Delacato (1974) as an act to reduce incoming stimuli. Such behaviour includes:

rocking, twirling objects, gaze aversion, covering the ears and humming, or staring immobile at a blank wall. Alternatively, in the underaroused state, the child manifests self-stimulation and other behaviour such as: hand-flapping, rubbing a rough surface, hand-biting, head-banging, and other self-mutilatory acts.

Ornitz and Ritvo (1968) interpret symptomatic behaviour, not as a compensatory reaction, but as a direct manifestation of the underlying state. Thus, for them, the child reacts to hyperarousal with excitation, and to hyper-inhibition with underresponsiveness. They argue that, because perception involves a memory of sensory constancies and similarities, a failure in reticular homeostatic regulation would result in a confusion in interpreting sensory information. Thus, identical sensations from the environment may not be experienced as identical each time, leading to a variable underloading and overloading of the central nervous system. In the excitatory state, among some of the behaviours manifested are hand-flapping, sudden lunging, and accentuated startle. The inhibitory state is seen in posturing, prolonged immobility, and lack of responsiveness to external stimulation.

The fluctuation between states may operate as a form of "gating mechanism" as proposed by Melzack and Wall (1965). In both phases, the child will have difficulty learning to depend upon information beyond near-space and remains bound in a concrete, contact receptor dominated mode.

Up until this point in Chapter I, the nature of the autistic syndrome has been discussed with special emphasis on the abnormal response to sensory stimuli. Also presented was a review of the research carried out to date which points to a perceptual defect in autism. In the following section, this background focus will be narrowed to the rationale for the present study.

The Rationale for the Study

When one observes autistic children in open-environment situations, their abnormal response to stimuli is a predominant characteristic of their symptomatic behaviour. This perceptual perspective has been included in both the theoreticians' attempts to propose possible causes of the syndrome, and clinicians' efforts to make more reliable a differential diagnosis. In contrast to some of the other theoretical approaches to the syndrome, for example the psychoanalytic and psychoneurological views, the perceptual view seems to not only provide the most comprehensive framework within which to incorporate autistic behaviour, but it also allows the researcher and clinician to tie together practical observations with theoretical inferences.

The observation that autistic children show a particular pattern of receptor usage is widely reported in case reports. Their characteristic mode of relating to the environment is to smell, taste, and touch more frequently than they learn by seeing and hearing. In fact, an aversion to the latter sensory modes of information gathering is widely reported. When we observe the hypersensitivity and startle reaction to objects which intrude from a distance and also infer the function that the distance receptors serve both phylogenetically and ontogenetically, we come to understand better the relationship between abnormal perceptual activity and autistic behaviour as observed, Schopler noted this abnormal activity in autism and conceptualized the level of functioning within the framework of a contact receptor dominance over the distance receptors. He conceived of the former as a stage through which the normal child passes and beyond which the autistic child has difficulty developing. In this way he placed the problem of autistic behaviour on a continuum of perceptual development. The autistic child's functioning is seen as an alteration in the normal hierarchy of receptor dominances. It is from these theoretical premises that the present study is conceived. The first purpose of the research, stated broadly, is to investigate whether the differences observed between autistic and normal functioning by Schopler (1965, 1966) in environmental exploration and by Hermelin and O'Connor (1970) in visual tracking can be measured within the contact-distance receptor division. The second and major aim of the study is to investigate whether the autistic child, if given the opportunity through training to explore earlier modes of functioning, will progress in his perceptual development. Should the sensory discrimination training experience be successful, this would diminish his excessive reliance on his contact receptor modalities.

According to Ayres (1977) there are no known experimental studies of sensory training. There are, however, reports by Schopler (1964) and Delacato (1974) of individual cases indicating the successful treatment of autistic children using contact receptor stimulation through bodily contact. Here, the therapist employed the tactile receptors as the most accessible channel for communication. Harlow's (1960, 1962) studies called to attention the importance of tactile stimulation for psychosocial development. He concluded that bodily contact plays a primary role in developing infantile affection. Casler (1963, 1965) studied the effect of tactile stimulation on the development of eight pairs of matched institutionalized infants under 1-year of age. He found that 20 minutes per day of light touch-pressure stimulation, over 10 weeks, resulted in significant gains on the Gesell Developmental Scale, compared to the nonstimulated group. Casler concluded that tactile stimulation made a difference in the maturational rates. These conclusions are supported by Eells (1961), Delacato (1974), and Ayres (1977). In spite of variations among individual autistic children, the contact receptor systems seem to offer a better starting point for establishing dependable perceptual patterns for the child than does the engagement with his distance receptors. It is proposed that, in order to develop the distance receptors, the child's receptor activities must be slowly directed away from his "near" bodily sensations and onto more "distant" objects. This would involve taking the child through the developmental process of receptor functioning. According to Jones and Hart (1968), the first developmental experiences, gustation, olfaction, and tactuality, take place within the radius of the child in "near-space." Very young, normal children are most comfortable in near-space, often seeking physical contact with somebody or something when they find themselves in a wide open space. The farther away they are from what they must watch and listen to, the more distracted they will be. As they begin to move about and gain direct experience beyond the length of their arms, their spatial world expands into "mid-space." With crawling, exploring, and general movement, kinesthesis becomes increasingly important. The child learns to cope with his own gravity in space. He now moves in all spatial planes--the vertical ("up" and "down"), the lateral ("left" and "right"), and the depth plane ("back" and "forward"). The child is always the centre of his spatial organization. "Up" is towards "my" head; "down" is towards "my" feet; and "in" is towards "my" mid-line. As the child orients himself in space, he uses this same scheme to orient other objects farther out in space. For example, the wall is behind the book because, in relation to him, the wall is farther away than the book. The spatial world expands from near, to mid, to as far as each area becomes experienced and organized. Mobility, as with all development, proceeds from the head to the feet, from gross to specific (Werner, 1948). Each advance is based upon the previous step and forms the basis for the next. Before the child can "know through hearing," he must have fully experienced and organized, gustation, olfaction, tactility, and kinesthesis.

When a child has sufficient experience to depend upon his auditory and then visual senses, he is capable of organizing "far-space." He can learn from sounds that his mother is cleaning in the next room or that his father's car has entered the driveway. According to Jones and Hart (1966), once vision and the other systems are organized at the "perceptual" level, the child has a basis for learning on a higher or "symbolic" level.

Based on the theory of Jones and Hart, a training program was constructed to take two autistic boys through the developmental sequence (G-O-T-K-A-V), with the use of discrimination exercises. The overriding emphasis borne in mind throughout was the development in receptor useage from near-to-far-space. The training provides the child the opportunity to proceed through the sequence, especially the shift from contact to distance receptors. In this way, the child is taken back to functions typical of a much younger age. Concomitant with this training is the emphasis given to the child's "body image." This term describes a person's awareness of his own physical dimensions and position in space. Kinesthetic skills reinforce a child's body-image and help him to locate himself in the spatial planes around him.

The crucial question which arises from autistic behaviour as it has been presented in this chapter may be phrased as follows: If there is an abnormal receptor dominance operating in the autistic child, and considering the theories of neurological involvement, what is the possibility of facilitating a shift from contact to distance receptor functioning? In other words, to alter the child's dominant mode of functioning from near- through mid- to far-space?

In order to investigate this, an instrument would need to be sought which can measure receptor dominance. The instrument has to be able to reflect pathological autistic functioning and also normal functioning against which the former can be compared. Should these different forms of receptor functioning be found, an important question would be whether they are in the direction of contact and distance receptor dominance as noted in the literature. If the autistic children were then given a program of training which attempted to produce a shift in dominance, the examiner would need to employ an autistic control group in order to judge whether any change effected was due to the training or to an uncontrolled effect such as maturation. A normal control group would be needed for similar reasons but also to assess whether the treated subjects changed in the direction of normal functioning and away from autistic functioning as measured from the autistic control group. Another important reason for using control groups would be to judge whether the instrument used to measure dominance is reliable over time. More specifically, to ensure that any change in the treated group was due to the training program and not to inefficiency in the measuring instrument. These questions may be more systematically formulated in terms of the hypotheses which follow.

Theoretical Hypotheses

1. The four autistic boys will show a substantial contact receptor dominance over both their distance receptors in the pretest.

2. The four normal control boys will show a distance receptor dominance over their contact receptor in the pretest.

3. There will be no substantial difference between pre- and posttest measures in the autistic control group for either touch, audition, or vision.

4. There will be no substantial difference between pre- and posttest measures in the normal control group for either touch, audition, or vision.

5. There will be a substantial difference between pre- and posttest measures in the treated autistic group for either touch, audition, or vision.

6. The treated autistic group will show less contact receptor dominance in their posttest than in their pretest.

CHAPTER II

RESEARCH METHOD

Chapter II will present the research strategy used to test the hypotheses stated at the end of Chapter I. It will present a section on the subjects who participated and also an outline of the research design. This will be followed by a description of the apparatus built for this study, and then a section outlining the procedure employed in the pre- and posttesting. The last two sections of the chapter will describe the training program used with the treated group and then, finally, the manner in which the results obtained were analyzed.

Subjects

Four autistic boys between the ages of 11 and 12 years from the School for Autistic Children were selected as subjects. As normal subjects are more readily available, their average age, 11 years 8 months, was matched according to that of the four autistic boys which was 11 years 10 months. The four normal boys were from a Grade 7 class at a local high school. All were volunteers and unpaid. They were selected by their class teacher who was asked to use the following criteria: they should be "well adjusted emotionally, have had their vision and hearing checked for acuity, and be within the bright-normal range of intelligence." Each autistic subject was checked against Creak's (1961) nine diagnostic points. Although all autistic subjects manifested impairment in their emotional responsiveness and resistance to change at the time of this experiment, none was severely autistic. When admitted to the school, which differed between 4 and 6 years of age for the group, they had each been psychiatrically diagnosed as autistic. All four boys had exhibited withdrawal from an early age, but improved considerably since that time. They were all verbal to the extent that the instructions given in this study were comprehensible to them. The autistic boys lived at home and attended the special school five days per week. All four autistic boys had been checked for sensory acuity and there was neither an auditory nor visual defect evident. The mean IQ of the four autistic boys on the Merrill-Palmer was 51, ranging from 40 to 64. Table 1 shows the ages of all subjects and IQ scores for the autistic boys. The two autistic boys assigned to the treatment group were selected at random. For a brief case description of each autistic boy, see Appendix 1.

Table 1

Ages of All Subjects and IQ Scores for Autistic Boys

Subjects	Age	IQ
Autistic		
1	12' 11"	57
2	11' 11"	64
3	11' 3"	40
4	11' 1"	43
	$\overline{X}$ = 11' 10"	$\overline{X}$ = 51
Normal		
1	12' 2"	
2	11' 6"	Bright Normal Range
3	11' 7"	
4	11' 5"	
	$\overline{X}$ = 11' 8"	

Design

The present study will be divided into two parts: the first will involve a comparison of autistic and normal children's receptor dominances. The second and major part will constitue the training of two of the four autistic boys.

In the measure of receptor activity differences, four autistic and four normal control boys each underwent the same testing conditions. Prior to these testing trials, each subject was presented with all stimuli consecutively. This was done to ensure that each child could perceive the various stimuli and was able to respond to each one. A criterion of 16 out of 18 correct training trials was set so that the autistic boys would not be at a disadvantage and could repractice until they met the criterion. Following the training period; that is, when the criterion was met, and without further instruction, two stimuli of different sensory modalities were presented simultaneously, one on the left and one on the right side. The order of presentation of bimodal stimuli combinations was randomized over 36 trials to prevent a response set from occurring. The six possible stimuli combinations were:

1. TOUCH (left) / LIGHT (right)
2. SOUND (left) / LIGHT (right)
3. SOUND (left) / TOUCH (right)
4. LIGHT (left) / TOUCH (right)
5. TOUCH (left) / SOUND (right)
6. LIGHT (left) / SOUND (right)

Each of six possible combinations of stimuli was presented six times, i.e., 36 trials. Subjects were required to point to which side he perceived the stimulus to originate from, left or right.

The two autistic boys who were selected for the receptor training program were seen over a period of five months. Each boy received an average of one half-hour session per day, totalling 10 hours per month, and thus a total of 50 hours training. Table 2 illustrates the manner in which the four normal subjects and the two untreated autistic boys both served as control subjects against whom the treated boys could be compared. The need for an "attention" control group has frequently been emphasized in outcome research studies. The rationale for this is to ascertain to what extent the effect of the program is attributable to attention received. All of the autistic children who participated in this study lived with their parents. The school they attended had a pupil-to-staff ration of 2:1 and they constantly received individual

Table 2

Subject Groups Pre- and Post-
Receptor Training

Subjects	Pretest	Training	Posttest
Autistic Treated			
1	X	50 hours	X
2	X	(5 months)	X
Autistic Control			
1	X	None	X
2	X		X
Normal Control			
1	X		X
2	X		X
3	X	None	X
4	X		X

attention. Due to these circumstances, as well as the shortage of autistic subjects, an attention control group was considered unnecessary.

Apparatus

To test receptor dominance, the equipment reported by Hermelin and O'Connor (1964) to present bimodal stimuli simultaneously was adapted for this research. In their study, they placed the two buzzers and lights, which constituted the auditory and visual stimuli on the left and right sides of the display panel. The tactile stimulation was provided by a length of string secured around the ankles of each leg. In the present study, the means for providing auditory and tactile stimuli were adapted to the sample.

During the construction of the apparatus, various alternatives were attempted in the presentation of stimuli. The technique of applying the touch stimulus to the ankles, used by Hermelin and O'Connor (1970), was found impractical as any shift in the position of the feet changed the intensity of the stimulus. The use of a mild "tingling" electric current was also attempted. It was found that, apart from differences in threshold levels between individuals, the difference between "pleasant tingling" and "aversive" also varied from day to day in the same individual. The risk, therefore, of a touch stimulus being avoided not because of receptor activity, but because it was aversive, became too great. A broader decision was to maintain "touch" as the contact receptor employed in this study as it is the central modality of the contact receptors and the one most frequently observed to be in use in autistic children. It is also the most amenable of the contact receptors to experimentation, certainly that which is most easily administered. What follows is a description of the modified equipment used in this experiment.

The equipment for the presentation of visual stimuli consisted of two red lights set into a hard-board display panel. These two lights (1" X 3/4") were placed left and right on the vertical section directly facing the subject, so that his head was approximately one metre equidistant from each light. The lights ran off two 6-volt "Eveready" D.C. batteries. The entire front surface of the panel was painted black to accentuate the light stimuli. Two "wings" of hard-board were built at 45° from the vertical front panel so that other potentially distracting stimuli from the visual field could be minimized. A similar panel was attached over the top of the apparatus to add to this effect. Figures 1 and 2 illustrate the display panel.

The equipment designed to deliver the tactile stimulus was built into a table with a surface (4' X 3') upon which the hard-board panel was placed. Two 12-inch

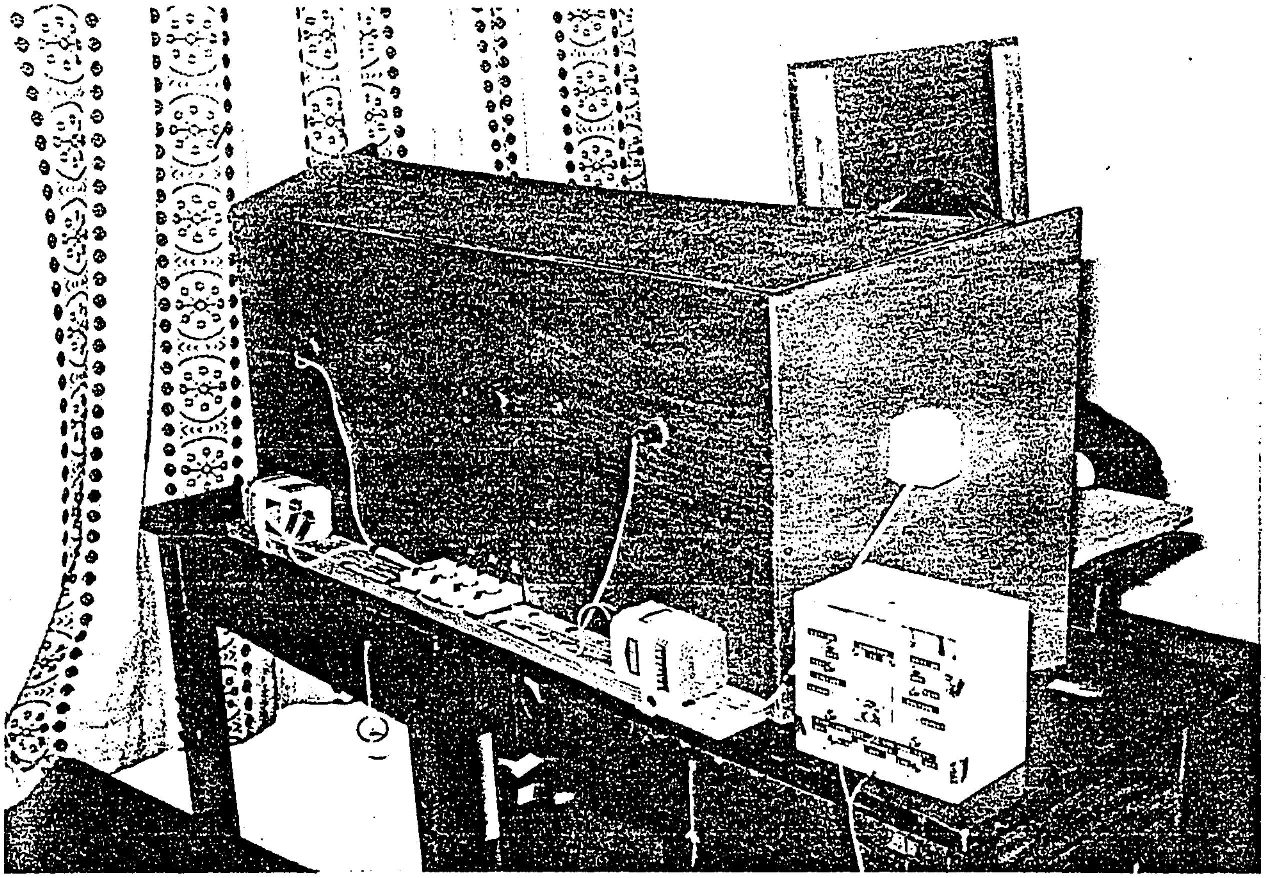

FIGURE 1 (above). Rear View of Testing Consol Illustrating Switches for Stimuli Presentation.

FIGURE 2 (below). Front View of Testing Consol Illustrating Position of Seated Subject.

wide wooden slats were bolted to the table, and positioned so that the subject sitting before the lights-consol could place his palms over the 3-inch wide hole on each slat and also rest his forearms (see Figure 2). Using a system of levers, the touch stimulus was presented by a small hard brush placed underneath each hole. When the ring was pulled by the experimenter from the other side of the table, the brush was raised through the hole one centimetre above the surface of the wooden slat. On release of the ring, the brush being attached to a spring, returned immediately to a position below the hole. Each presentation produced a tactile stimulus of standard intensity.

The auditory stimuli, left and right, were presented through stereo headphones (Akai ASE-95), which were attached to a tone generator. The controls of this tone generator were monitored by the experimenter who could alternate the tone to left or right with a "flip-flop" switch. The tone selected was that of a middle C, a fairly central frequency and audible to all subjects. One 6-volt D.C. battery was used to power the tone generator which was placed behind the hard-board panel.

Other apparatus included two chairs; one for the experimenter unseen behind the panel, and one for the subject. Also used were 16 score sheets used by the scorer (see Appendix 2).

The four switches for left and right light and tone, as well as the two ring loops, were placed close together so that bimodal stimuli could be presented quickly, and that no lengthy stretching movements could give a cue to the subject.

No attempt was made to establish any form of stimulus-equivalence between the modalities. The intensities used were based upon the judgment of the experimenter and several normal subjects who agreed to test the equipment during the building. Ideally, the stimuli used could be sufficiently under the experimenter's control that he is able to, for example, adapt the pitch and intensity to the child's audiogram.

A definite improvement to the equipment for presentation of bimodal stimulation would be to write a computer program that would allow the entire process to be automatically controlled. Due to the nature of the test, the scoring of responses could never be mechanized because substantial visual judgment is constantly required.

Procedure for Testing

This section will deal specifically with the procedure followed in the pre- and posttesting.

The subjects were tested while seated facing the panel which was shown earlier in Figure 2. The experimenter placed the subject's hands, palms down, over the holes on the wooden slats. In the case of the headphones, these were carefully placed over the subject's ears and adjusted for size. The experimenter then took his place behind the hard-board panel so that: (a) he could present the various stimuli, and (b) remain hidden from the subject to prevent any "nonverbal cues" being given. The scorer, who was kept naive to the hypotheses, then took over and read the instructions to the subject.

The instructions given to the autistic and normal subjects differed due to the differing levels of comprehension in the two groups. In the case of the former, a period of up to 10 minutes was given to become familier with the room and the apparatus prior to being seated. The autistic boys were allowed during this time to press the buttons for the lights and become accustomed to wearing and hearing the tone from the earphones in order to reduce the anxiety attached to these stimuli.

The instructions to the autistic group were:

> There is no need to be afraid. Nothing here will hurt you. You have already heard all the sounds and seen the lights. This is not a long game, so please try your best ... [John], which is your right hand? ... That's right/No your other one ... and now your left hand? ... That's right. What you have to do is point to the side from where the light or sound or touch comes. ... We'll go through what you have to do one more time.

If serious difficulty was experienced in indicating the sound of the stimulus, the child was eventually told to point towards whichever side he noticed first.

Instructions to the normal group proceeded as follows:

> There is no need to feel worried as the test is not difficult, nor will it hurt you. What you have to do is this: When the tone sounds [press tone], or when the light goes on [press light], or when you feel a touch on your hand [pull light], you have to point to the side from which the sound, light, or touch comes. It's as easy as that. Do you understand?

All stimuli, both training and experimental, were presented for approximately 2 seconds during which the experimenter counted mentally, "a hundred and one, a hundred and two," at which point the finger was lifted from the light or tone switch and the brush released. At first, the experimenter presented the 18 training stimuli consecutively and the scorer marked the score sheet for the stimuli which the subject reported correctly. If the criterion of 16 out of 18 correct responses was met by the subject, the scorer nodded once to the experimenter who proceeded into the experimental trials without any further instructions being given. Alternatively, if the criterion training score was not met, the scorer shook her head once and the experimenter proceeded to repeat the training stimuli until the criterion was met.

In the experimental trials, the experimenter presented 36 bimodal stimuli combinations. The responses to these trials were recorded by the scorer. As the subject had to respond after two stimuli were presented simultaneously, the subject could not be scored as "incorrect" as in the training trials. The function of the scorer here was merely to record whether the subject indicated "left" or "right."

Between every trial, both training and experimental, there was a time period of about 3 seconds. The hidden experimenter would, after presenting each stimulus, mentally count, "a hundred and one, a hundred and two, a hundred and three," before presenting the next stimulus. In this time period during the experimental trials, the scorer had to record the score if she considered it as a valid trial. A "contingency plan" was worked out in the event of different incidents and responses occurring. Included here was the definition of a "no-trial." This was considered when: (1) the subject was not looking at the instrument panel, (2) when there was a doubt as to whether the subject could see a light, and (3) when the response was ambiguous. When a no-trial occurred, the scorer would shake her head once in the same manner in which she did so to signal that the training criterion was not met. If the subject's attention appeared to be drifting, the scorer would say: "Please look in front of you."

At the end of the experimental trials, each child was thanked for participating and told that he had "passed" (to the autistic boys), or "performed well" (to the normal boys). In both the pretest and posttest, which were separated by a period of 5 months, the above procedure was carried out with as much attention to detail and control as was possible with the autistic group.

Working with autistic children frequently provides substantial problems in itself. One boy had to be tested for four consecutive days before he was able to complete the test. In general, many trials had to be repeated as they fell within the definition of a "no-trial." With the normal subjects, however, the need for repeated trials was relatively infrequent.

An important factor in the testing procedure, which may easily be underestimated, is that of the relationship between the experimenter and the autistic boys. It is not unusual for these children, whose teachers know them to be relatively intelligent and testable if handled in the correct manner, to be returned from a testing agency as "profoundly retarded" or "untestable." An autistic child is wary of all humans, but more especially so with strangers. As a consequence, a familiar face in a new threatening environment can often help to provide a source of security and continuity. The experimenter had worked with these boys for three years and was familiar to them all. The autistic child, placed in a testing situation without someone who knows how he "normally" behaves and of what he is capable, will probably react by withdrawing and acting stereotypically "autistic."

Receptor Dominance Training

Construction of the Training Program

The goal for the 5-month training period was essentially to shift the child's focus of receptor dominance away from the contact receptors in near-space, proceed through mid-space, and onto the distance receptors and far-space. The framework used to order the program was along the developmental sequence outlined by Jones and Hart (1968). Each exercise or "game," as it was presented to the children, was selected primarily according to its appropriateness within the G-O-T-K-A-V sequence. A second consideration was the extent to which the discrimination task and response required of the child focused on the one modality in the sequence being emphasized in that part of the training. The exercises, which were arranged in stages from gustation through to vision, were designed specifically to help the child discriminate and organize these sensations through experience.

Although the construction of the overall program was original to this study, most of the exercises employed were adapted from various remedial teaching manuals (Braley et al., 1968; Francis-Williams, 1961; Monroe, 1951; Russell et al., 1959; Van Witsen, 1973). In the next subsection, the various exercises will be described and reference will be made to the source and how the idea or exercise was adapted from the original.

What follows now is an outline of the program for the 5-month period of training. Table 3 shows the modalities emphasized during the program.

In phase 1, which consisted of the first three weeks, attention was given to gustation and olfaction. The second 4-week period, phase 2, was spent on tactile exercises initially, followed by a series of kinesthetic exercises. Jones and Hart (1968) point to the fact that kinesthesis is linked to body-image and, therefore, from the ninth to the fifteenth week, the first 15 minutes of each session were spent with "body-awareness" training, and in the final phase, "spatial awareness" exercises. Weeks 9 to 15, phase 3, was an important stage because it was here that the transition was attempted from contact to distance receptor emphasis. During the last five weeks (16 - 20), the exercises were largely of an auditory and then, finally, visual nature.

Table 3

Amount of Time Spent at Each Phase of Training Program

Phase	Duration	Emphasis
1	Week 1 - 3	G + O
2	4 - 8	T + K
3	9 - 15	K + (AV)
4	16 - 20	A + V

Contents of the Training Program

This subsection will describe the program of exercises employed, their sources, and the manner in which they were modified.

Phase 1 (G + O)

Gustation. The child must learn to discriminate taste, temperature, and textures, and also to move his tongue and mouth as and when he wants to. Eating is the basic training for gustation. A child has made substantial preparation for speech when he can chew, keep food between his teeth, drink through a straw, and move his lower jaw to grind food.

1. A "taste-box" was prepared containing items of food with characteristic tastes: chocolate, mild cheese, salt, sugar, ketchup, banana, toothpaste, an orange segment, a grape, vinegar, and egg yolk. The child was blindfolded and had to identify each object placed on his tongue. At times this was varied by presenting a taste-object and then later presenting four tastes from which the child had to identify the original object presented. Bitter, sweet, sour, salty, and sharp tastes were all experienced. The child was reassured many times that only pleasant substances would be given. When taste-objects such as vinegar or cheese were presented, they were in a mild form. The idea for this exercise was

derived from Van Witsen (1973) who employed a "smell-box" to teach discrimination. In his manual, he merely presents the objects for identification.

2. Tongue exercises. The therapist touched areas on the child's lips and mouth with a teaspoon. The child was required to retouch these areas with his tongue. This exercise was not derived from any manual.

3. Simple games were played where questions such as "Is this chocolate?" had to be answered with a movement of the tongue. Each movement represented a different response, i.e., "yes"--vertical and "no"--horizontal. This exercise was also invented for the purpose of the program.

Olfaction. Gustation and olfaction are intimately related senses and cannot, in practice, be truly separated.

Nonetheless, (1) a "smell-box" was prepared containing a cigarette butt, a coffee cup, a raw onion, soap, peppermint toothpaste, an orange, paint, leather, perfume, and chocolate. With the exception that objects were not placed on the tongue but smelled, a similar method of identification to that used in gustation was employed. The child was blindfolded and asked to identify the smell and then, later, to isolate one of a series of smells. The exercise was taken, in its first part, directly from Van Witsen (1973) although different objects were used as stimuli to that described by him.

2. While the child is taken out walking, his attention was drawn to environmental smells: freshly cut grass, flowers, cooking, tree bark, leaves, rubber and gasoline. When walking outdoors it was found that wax earplugs and sunglasses helped to reduce the child's anxiety reaction as they allow in sufficient stimuli but take the sharpness out of stimuli. Reference to the practice of calling attention to environmental smells is quoted in both Francis-Williams (1961) and Van Witsen (1973).

Phase 2 (T + K)

Tactuality. 1. A duplicate set of 30 "touch-cards" was made with varying surfaces from different grades of sandpaper to fur, leather, satin, tweed, suede, cotton, matte paper, cellophane, glossy paper, silk, rubber, and different woods and canvasses. The duplicate cards were identical for texture, but different in shape and colour. The child had to match the cards for texture while disregarding other cues of form and colour. This exercise appears in Van Witsen (1973) in a slightly different form, whereby the child has to identify the texture verbally and match it against a second set of identical cards. Another variation of this exercise developed by the therapist was to present a single card from one set and the child had to find the corresponding card in the other set, with and without a blindfold.

2. In a similar manner, a duplicate set of 20 "shape cards" consisting of cut-out triangles, circles, squares, and rectangles of different sizes had to be matched using only touch (blindfolded). This exercise was developed by the therapist based upon the idea of the "touch cards" presented by Van Witsen (1973).

3. One set of "shape cards" was examined one by one using only touch and these had to be drawn on paper and then later on a chalk-board. This exercise was derived from Monroe (1951) who presented different objects, a mannequin or an animal, to children and required them to reproduce the contour on paper.

4. Given one set of "touch cards," the child was instructed to order them without looking from "smoothest" to "roughest." This exercise was derived from Van Witsen (1973) who placed various household objects in a box and required the children to order them.

5. Shown a piece of wood and a piece of cotton-wool, the child was taught the difference between "hard" and "soft." He was then required, without looking, to categorize various objects: a sponge, rubber, clay, pottery, terry-cloth, dough, metal, stone, felt carpeting, glass. This exercise was adapted directly from Braley et al. (1968), except that their task included vision.

6. A variation was carried out with the criteria "warm" and "cool" using different size stones, glass, paper, flannel, cold and warm water, metal, ice, and a warm-water bottle.

7. The child was given three blocks with different shapes: square, spherical, and conical. Each block was given a name, "housey," "baldy," and "ice-cream," respectively. The child was required to identify the block when placed in his hands while blindfolded. This exercise was invented for the program.

8. The therapist touched the blindfolded child at various points on his body and the child was to point to where he had been touched. Later, this was repeated using a soft brush, sandpaper, and a feather so that the child could experience different intensities of touch stimulation. This exercise was adapted from a suggestion by Russell et al. (1959) who used this in body-awareness training whereby the child had to rename the body-part touched.

9. A picture of an object was shown: a pencil, a key, a flower, a ring, an egg cup, a saucer, a fork, a spoon, and an eraser. The subject was required to find the object in a bag by touch alone. This was adapted directly from Francis-Williams (1961).

<u>Kinesthesia</u>. During this stage, emphasis was slowly shifted away from near-space. Initially, various exercises were undertaken focusing on balance and control. This was followed by body-awareness and, finally, spatial-awareness.

Balance and control. These exercises were modeled by the therapist.

1. Leg-raising, alternately and together, from a supine position.

2. Toe-touching, left and right, both ipsilateral and contralateral. At first, the therapist sat alongside and later across from the child.

3. Various games were played that involved crawling races, crawling over obstacles; "over" chairs, "under" tables, "around" boxes, "between" blocks. Also, sliding across the room with a beach ball held under the stomach, and "stepping stones" across the room on sheets of paper.

4. Racing across the room with skate-board held under the body, kicking off from the wall.

The above Balance and Control exercises were adapted directly from Van Witsen (1973).

<u>Phase 3 (K + AV)</u>

<u>Body-awareness</u>. 1. The therapist modeled for the child as follows: "This is my head, touch your head." A similar sequence was followed through the various

body-parts: mouth, ears, arms, chin, elbows, knees, feet. This exercise was adapted directly from Francis-Williams (1961) for use with children with poor body-image.

2. This "game" was developed from the one previously described. Body-parts had to be touched by other body-parts: nose to knee, chin to chest, ear to shoulder, hand to hips, chin to wrist, elbow to knee. A variation of this was developed so that the child had to touch and name body-parts on the therapist.

3. A further variation on this theme required the child to touch body-parts to surrounding objects: head to floor, hands to wall, back to chair, nose to window, arm to door.

4. The child had to imitate the therapist in the movement of a body-part: nod your head, blink your eyes, open your mouth, raise your knee, stamp your foot. At first, this was carried out nonverbally, but later each was paired with the verb and body-part. This exercise was developed from the original cited above in (1) and adapted from Francis-Williams (1961).

Spatial awareness. The three planes--vertical, lateral, and depth--were considered. The shift from body to spatial training involved a considerable amount of modeling by the therapist of what was required. This shift occurred in the final three weeks of phase 3. Horizontal, lateral, and depth directionality were almost identical in their procedures. Therefore, what will be presented here is the procedure used to train lateral directionality. Due to the nature of these exercises, perhaps the most efficient manner with which to communicate them is in direct speech. As will be noted, a greater use was made here of audition and vision as secondary modalities.

1. This is my left/right hand [models]. Show me your left/right hand [practice].

2. Point with both hands towards your left side ... and now your right. Show me your left hand. With your left hand point towards your left. With your right hand point towards your right [practice].

3. Show me your left hand. With your left hand point towards your right. With your right hand point towards your left [practice].

4. With your left hand, touch your left shoulder ... with your right hand, touch your right shoulder ... with your left hand touch your right shoulder. [When learned, "shoulder" became substituted by elbow, knee, foot, and hand.]

5. With your left/right hand point towards your left and now your right.

6. [Sitting opposite the therapist] Which is my left hand? .. With your left/right hand touch my left/right hand. With your left hand touch my right shoulder. With your right hand touch my left shoulder [practice].

7. Go and stand on the left side of the table ... and now on the right. Stand with your right side to the window [repeated with different locations].

8. Is the door of this room to the left or to the right side of the cupboard ... and the bookshelf ... the mirror [practice].

The exercises for lateral directionality were constructed by the therapist.

Phase 4 (A + V)

Audition. During this stage, emphasis was put as much as possible on far-space.

1. The therapist bounced a beach ball on the ground up to four times. With eyes closed the child had to say how many times the ball bounced. The number of times was varied. If he did not want to count, he could imitate the correct number of bounces. This exercise was adapted directly from Monroe (1951).

2. The child had to identify a range of sounds without looking. At first, he was required to copy it and, later, to name it:

tearing paper	ring bell
sharpening pencil	pour water
clearing throat	open window
blow nose	jiggle money
snap fingers	coughing
knock on door	clapping
crumble paper	jiggle keys
dropping an object	sighing
bouncing a ball	leafing through book

The idea behind this exercise was taken directly from Van Witsen (1973), but many of the specific items were new.

3. The child sat with his eyes closed and had to say whether a sound was "near" or "far." The different

sounds listed in (2) above were used for this purpose. The exercise also developed as a variation of (2).

4. The therapist played a piano scale and the child had to riase and lower his arms with the pitch. He also had to walk up and down a small staircase according to the pitch of the scale. This idea appeared in both Russell et al. (1959) and Van Witsen (1973).

5. The child imitated a series of prerecorded animal noises: a dog, different birds, a lamb, a duck, a horse, a chicken, and a turkey. This exercise was planned by the therapist.

6. The therapist pronounced a word, then he repeated the same word or a word that sounded similar. The child had to say whether the words were the "same" or "different." These words were: dug-duck, bag-back, chip-ship, less-let, rode-wrote, shoe-chew, beg-bag, day-they, feel-fill, oil-earl, tin-thin, and sleep-slip. This exercise was adapted directly from Van Witsen (1973), but appears also in Braley et al. (1968).

Vision. Visual perception activities included eye-movement, form activities, form perception, visual memory, visual comparison, and eye-hand coordination.

1. The therapist sat in front of the child with six objects on his lap: a ball, a cup, a doll, toy horse, a pencil, and a toy car. With his left hand, he held each

object up to the child's left. The child was then asked to identify it and, while his attention was on the object, another was picked up and held to his right. The objects then became more and more quickly exchanged. Later, head-movements were reduced in order to produce rapid eye-movements, left and right. This exercise was adapted directly from Van Witsen (1973), apart from the fact that he used flash-cards.

2. In order to teach shifting the attention from near- to far-space, a pencil was held erect 10 inches from the child's nose. He was then instructed to practice focusing from the pencil to the far wall. The pencil was then brought closer and eventually the eye-movements were broken down to include near-space (pencil), mid-space (a wall poster), and far-space (the tree outside). This exercise was adapted from Van Witsen (1973) who used only "near" and "far" distances.

3. The therapist placed five familiar objects on a table and covered them with a cloth. After looking briefly, the child had to recall the objects he had seen. This was repeated with many different objects: books, cutlery, crockery, toys, vegetables and fruit. The exercise was developed by Francis-Williams (1961).

4. The child had to re-organize a picture of a human face, and later, different animals. These were cut

into four or five parts after the child had seen the intact picture. Many of the pictures used were cut from old magazines. The idea for this exercise came from the Object Assembly subtest of the Wechsler Adult Intelligence Scale.

5. With curtains drawn, the therapist and child played "tag" using flashlight beams on a wall. The child's beam had to catch that of the therapist and vice versa. This exercise was adapted directly from Van Witsen (1973).

6. Following the exercise above, the therapist made certain patterns on the wall with the torch beam: circles, squares, vertical, horizontal, and triangles. The child had to imitate this pattern. Later, the child had to reproduce this pattern on paper and on a chalk-board after the therapist had made the pattern on the wall. The exercise was a variation of the "tag game" cited above.

7. The child was required to sort different beads according to colour, different blocks according to shape, and different types of pasta into piles. The idea for this exercise came from Monroe (1951), who mentioned the classifying according to colour.

8. The final exercises consisted of an assortment of activities: pounding nails into wood, soap carving, clay modeling, and simple origami.

<u>Application of the Program</u>

It should be clear from the description of the program that it could not have, and did not deal with, any one modality at any phase to the exclusion of all others. The therapist attempted, however, to limit the amount of stimuli in order to focus the child's attention on the particular task emphasizing one modality and especially the spatial area involved. To this end, the room used for training was chosen for its quiet location, and also for the amount of control the therapist had over lighting. It was essentially a playroom which allowed toys to be concealed in cupboards, well-carpeted for sound absorption, and a dark blind that could completely darken the room. To emphasize the spatial areas involved, the therapist was aware in the near-receptor phases of training to move in close proximity to the child. As the training progressed, he moved in accordance with the modalities he wished to emphasize. Much use was made of modeling in eliciting a response. As much as possible, this was done especially with the near- and mid-space training. When the therapist did not want to blindfold the child completely but merely to reduce incoming stimuli as some sight was needed, sun glasses were used. In the same way, the sound environment was reduced with wax earplugs.

The therapist structured the situation; that is, he presented the material so that the goals and the required responses were defined, and the procedure was built in a step-by-step sequence. Freidus (1960) suggests six aspects of teaching the retarded child which apply equally well to this training and served as a checklist for the therapist. These aspects can be summarized as follows:

1. Sensory stimulus. Is the sensory equipment intact?

2. Voluntary focus. Can he pay attention or is he too distracted by other stimuli?

3. Understanding. Does he perceive the task correctly?

4. Intended response. Does he know how he is expected to respond?

5. Performing. Is he able to make the response physically?

6. Feedback. Can he check that what he had done is correct?

Most of the exercise sequences were repeated many times with both subjects. Often, discrimination learning, in order to carry out an exercise, took longer time than the actual exercise itself. This, of course, was seen as part of the training program. The problem of distractibility is a severe one, and there were occasions when nothing could be achieved in an entire session. Although no form of reinforcement was used with individual exercises at any phase, it was felt necessary to motivate the boys to leave their classroom and regularly attend the training session. To this end, they were given a token in the form of a plastic chip each session they attended, and could exchange these every week for a small reward of, for example, a chocolate bar or a small toy.

As noted previously, both treated boys were familiar with the therapist, and he with them. It was, therefore, somewhat easier to establish rapport and particularly to overcome the type of extreme caution with which autistic children characteristically approach strangers.

The autistic boy, R.Z., responded very well overall to training. He appeared to enjoy the gustation and olfaction exercises and learned to discriminate very quickly the different tastes and odours. Some considerable time was spent on exercise (8) of phase 2 involving touching individual body-parts. He had difficulty with this, and it was suspected at this early stage that he would be especially deficient in Phase 3 involving body-awareness. This proved to be true, and he took two weeks to understand exercise (1) of Phase 3. Once he had a fundamental knowledge of one part, he had little difficulty touching two named parts together. He was not able to comprehend the verb in, for example, "nod" your head but could model this. When the emphasis was shifted to spatial-awareness, he began to resist and, although he indicated at times that he could differentiate left from right, back and forward, he often pretended he could not and watched for the therapist's reaction. In fairness, however, he did experience some difficulty as the tasks required increasingly complex responses. The auditory exercises presented little difficulty for him, especially the auditory discrimination exercises (2) and (6). He became extremely excited when required to imitate animal sounds and could not continue the session. The visual flashlight games in the darkened room presented some problems for him as he was fearful of the dark. It was decided to proceed solely with the chalk-board and reproducing this on paper. He also had extreme difficulty focusing from near-space (the pencil) to far-space (a distant tree). Many of the visual exercises had to be repeated for several sessions before completion.

The second boy treated, G. B., was more problematic in training as his frequent diversions into other activities took much time from each session. During Phase 1, he was afraid initially that the therapist would "play a trick" and place something noxious on his tongue or under his nose while he was blindfolded. During exercise (3) of Phase 1, it was noticed that he had difficulty controlling his tongue sufficiently to move in a vertical or horizontal direction. Later it was found that his problem lay more in the comprehension of "side-to-side" and "up and down." He had no difficulty with tactile exercises (1) and (3) using "touch" and "shape" cards as this sense was particularly well developed. The naming of body-parts in exercise (1) of Phase 3 presented a severe problem and two entire weeks were spent on this task. Kinesthetic games were particularly enjoyed and he often had to be quietened after a session of crawling obstacle races, and "stepping stones" on paper. He resisted strongly the spatial-awareness training and frequently threw a tantrum when attempts were made to teach directionality, especially, for example, when two directions were involved in the instructions. After many weeks he was able to judge fundamental directions such as "left-right" and "above." When emphasis was shifted to far-space, particularly vision, he insisted that the training return to exercises completed at an earlier stage, particularly those in Phase 1. When these objections were overcome, he enjoyed the auditory tasks, but would need to keep his eyes closed, for example, in the animal imitation and raising arms to music exercises in Phase 4. He was unable to master the task requiring differentiating similar sounding words, and this was past over. Of the visual exercises, he was unable to recall more than two of the five objects hidden, but had no difficulty re-organizing the picture of the human face when cut into pieces. Much of his visual activity involved short, darting glances, but these tended to become longer over the training period. He experienced great difficulty with the visual sorting exercise, and was unable to comprehend this. He had, however, been able to learn to discriminate "hard" from "soft" earlier.

In general, the training of the second subject, G.B., was more difficult and taxing for the therapist. It was necessary, at times, to depart from the program in both cases and follow the child with his "distraction" before he could return to the task at hand.

This section has dealt with the construction, contents, and application of the training program which aimed to alter the receptor dominance in two autistic boys. In the next section, the form of analysis employed to evaluate receptor dominance on the pre- and posttest will be presented.

Treatment of Results

This section will be divided into (a) a discussion of problems encountered with small-sample statistics, and (b) the criteria used to evaluate change with reference to the six hypotheses stated at the end of Chapter I.

Problems with Small-sample Statistics

Increasing attention is being paid to the problems concerning the application of conventional statistical analysis to N = 1 and small-sample research (Gentile, Roden & Klein, 1972; Hartman, 1974; Michael, 1974). This concern is long overdue and lags behind the type of parametric statistical analysis established by Fisher (1925).

The major objection to the use of parametric statistics with small samples concerns violation of the assumptions underlying the test. The implications of this are that if significant results are obtained, there is some question as to whether this is due to a genuine difference or to a violation of the assumptions. The *t* test and *F* test of analysis of variance are dependent upon sampling from a normal distribution. A second assumption required is that the variances of distributions from which the samples have been taken are the same, termed "homogeneity of variance." A third assumption which is not necessarily relevant to the small-sample problem is that scores used in the test exhibit independent errors.

There is, however, some controversy between statisticians as to the use of parametric techniques with small samples. Lindquist (1953), Boneau (1960), and Gentile et al. (1972) propose that the *t* and *F* tests are sufficiently "robust" to be relatively immune to violation of the assumptions. Lindquist (1953) presents the results of a study using a technique to obtain samples of *F* scores by means of a random sampling procedure from distributions having the same mean but which violated the assumptions of normality and homogeneity of variance. As a measure of the effect of the violations, he determined the obtained percentage of sample *F*'s which exceeded the theoretical 5% and 1% values. He found that when the samples all came from the same population and for samples from populations having the same shape but different variances or different shapes with the same variance, there was little effect on the percentage of *F* ratios exceeding the theoretical limits. Lindquist concludes that:

> Unless the heterogeneity of either form or variance is so extreme as to be readily apparent upon inspection of the data, the effect upon the *F* distribution will probably be negligible (p. 86).

It might be argued that the problem of violating the assumptions in small samples may be overcome with better planning of the experiment, but this is not always possible when dealing with a population where only a limited number are available.

The prospect of violation is sufficient to consider alternative methods. One possibility is that of nonparametric or distribution-free statistics. Unfortunately, they generally combine their freedom from restricting assumptions with an overlooking of much of the information contained within the data. For example, by ranking scores above and below the median, one ignores the fact that there are intracategory differences between the individual scores. As a consequence, tests which make no assumptions about the distribution from which one is sampling will tend not to reject the null hypothesis when it is actually false as often as will those tests which do not make assumptions. This lack of power in the nonparametric tests is a real handicap when the magnitude of a treatment difference is paramount.

In the literature, the problem of small samples is not merely a matter of developing especially powerful techniques, but also whether conventional statistical analyses need be used at all to evaluate change in intra-subject and small-sample designs (Michael, 1974). In many clinical psychology journals, there is a great reliance upon descriptive statistics such as the mean, percentages, and graphical figures, without any accompanying significance testing (for example, the Journal of Applied Behaviour Analysis, Journal of Autism and Childhood Schizophrenia, and the Journal of Experimental Analysis of Behaviour). A highly successful area where there has been a near avoidance of inferential testing is that of "operant conditioning" (Sidman, 1960). This may be due to, as Gentile et al. (1972) suggest, an assumed inapplicability of traditional techniques to small samples.

Using the term "judgment" to refer to any decision or reaction that a researcher could make to his data, descriptive and inferential statistics, suggests Michael (1974) are both "judgmental-aids." Critics of inferential methods, well documented by Kazdin (1973) and Sidman (1960), point out that what started as a supplement to other bases of judgment, has become overvalued and promoted a tendency to design experiments around an "appropriate" test. A criticism by Michael (1974) suggests that the test by itself is an incomplete basis for a judgment because the use of any particular level of significance as a basis for distinguishing "real" from "chance" effects tends to be too rigidly interpreted. Skinner (1972) poses the question whether in the last 40 years since these techniques have been widely employed in experimental psychology, the field is more effective because of them. Skinner remarks further that most of our scientific knowledge today is based upon methods of inquiry which have not been statistically analyzed.

Nevertheless, the case for inferential statistics remains strong because complex experimental results often cannot be easily interpreted when simply displayed graphically or as a table of mean scores. Significance testing is particularly important to the applied researcher as he often cannot discontinue a study until he can experimentally control a source of irrelevant variation. Faced with data that do not make up a sufficient basis for judgment, the researcher and later readers can react more efficiently if they have the aid of an inferential procedure.

Criteria Used to Evaluate Change

An important differentiation in outcome research relates to the criteria for evaluating change, particularly the importance of experimental versus clinical significance. The latter, according to Risley (1970), refers to a comparison between the behaviour change and the amount of change required for the patient's more effective functioning. When a behaviour is changed according to objective data and when a specified behavioural goal is attained, the program has achieved a change of clinical significance. Apart from this clinical criterion, the experimental criterion refers to the reliability of change. Basically, this involves a comparison between the behaviour following the intervention with what it would be if the intervention had not been undertaken. In intrasubject designs, when the plotted performance during intervention does not overlap with performance during baseline, and if this is replicated over time (A-B-A-B), this is an indication of experimental reliability. In the case of intergroup variability, a comparison is made between change in the treatment group and the random fluctuations over time of the training program in the control group. As important as replication over time is in the single-subject design, is the consistency of the change for all subjects treated in the intergroup design.

Due to the shortage of autistic children generally, especially those who are sufficiently verbal to participate in this type of research, and the time required to train each child, the small sample used in the current study was unavoidable. It was decided to use what Solomon (1949) terms a "pretest-posttest control group design" (p. 300), and not a single-subject approach for the following reasons: Firstly, the nature of the study required a comparison between normal and autistic functioning and, secondly, the training program was more conducive to a control group comparison than to an A-B-A-B type intervention.

Based upon a cautious approach towards violating parametric assumptions, and the controversy which exists concerning small samples, it was decided that the results of the present study would be presented in a descriptive and visual form employing tables of mean scores and percentages, and also graphical figures. However, because some controversy does exist, a statistical analysis of the data has been made in the appendix. Any small N study, suggest Gentile et al. (1972) and Michael (1974), that shows significant treatment effects may be interpreted at least as indicating that, for the particular subjects used, the variance attributable to treatment is sufficiently larger than one might obtain by chance. Generalization to the population, or "external validity" as Glass and Stanley (1970) refer to it, must be demonstrated by further study.

To evaluate receptor dominance on the pretest and also whether change occurred following training, it was decided to set certain criteria to be met in the absence of a significance level. These criteria would attempt to ensure that, firstly, the receptor dominance or change in dominance is consistent for each subject in the group. Secondly, that change is substantially greater between pre- and posttesting than fluctuations seen over time in the control groups. Thirdly, that the receptor dominance or change in dominance is in the predicted direction as outlined in the theoretical hypotheses in Chapter I.

In the case of hypotheses 1 and 2 which predict contact receptor dominance for the autistic boys and a distance receptor dominance for the normals, the results will constitute Part 1 of the results as they are based on the pretest and employ different criteria for evaluation. The first criterion would be met if the receptor dominance is consistent for each subject in the autistic and normal groups. It may be noted that, in the hypotheses, a substantial dominance is predicted only for the autistic group.

This is because the autistic dominance for the contact receptors is based on pathology of functioning and a "substantial" dominance for the distance receptors in the normal boys could also be considered as pathological. Thus, the second criterion expects a "dominance" for the normals, but a "substantial" dominance for the autistic. The third criterion would be satisfied if the relationship of the receptor systems is in the hypothesized direction.

Hypotheses 3 to 6 will constitute Part 2 of the results and will employ the outlined criteria to evaluate any change following the training program. For the first criterion to be met, each change predicted should be consistent for each subject in the autistic treated, autistic control, and normal control groups. More specifically, following hypotheses 3 and 4, the no substantial difference between pre- and posttesting should be consistent for all subjects in the autistic control and normal control groups. Whatever change occurs in the treated autistic group should be consistent for both boys according to hypothesis 5. The second criterion would be satisfied, if change in the autistic group is substantially greater before and after training than fluctuations measured over the 5-month period in both the autistic and normal control groups. Hypothesis 6 relates to the predicted direction of the change in receptor dominance following training in the treated autistic boys.

For the third criterion to be met in the evaluation of change, the treated boys should move in the direction of less contact receptor dominance on the posttest.

The results obtained will be presented in Chapter III according to the division introduced in this section between measures of receptor dominance on the pretest, and pretest-posttest differences following training.

CHAPTER III

RESULTS

In this chapter the results will be presented in a descriptive and visual form using mean scores, percentages, and graphical figures following the rationale outlined in Chapter II. Part 1 of the results will deal with the pre-test measures of receptor dominance for the four autistic and four normal boys. Thus, Part 1 deals solely with theoretical hypotheses 1 and 2. In Part 2, the pre- and posttest scores of the two untreated control groups and the treated autistic group will be presented to illustrate the effect of training on receptor dominance. The second part of the results will therefore deal with hypotheses 3 to 6 which all make reference to predicted change over time.

Part 1 - Pretest Receptor Dominance

Each of the subject groups will be examined separately and any comparison made between them will aim merely to highlight their respective dominances. The reason for this is that in hypotheses 1 and 2 no attempt was made to predict autistic and normal receptor dominances in terms of any relationship to the other.

The pretest measures for the four autistic boys, set out in Table 4, indicate that their mean scores decrease from touch, through audition to vision. These same pretest measures for the normal boys in Table 5 show an increase in dominance from touch, through audition to vision. The relationship between autistic and normal subjects across modalities is illustrated in Figure 3. In the autistic group, the mean scores for touch, audition, and vision out of a possible 24 are: 16.25 (45%); 11.75 (32.6%); and 8.0 (22.2%), respectively. This indicates a difference between touch and audition of 4.5 (12.4%) and between touch and vision of 8.25 (22.8%). The difference in the means of the two distance receptors, audition and vision, is 3.75 (10.4%). For the normal control group, the mean scores for touch, audition, and vision are: 9.75 (27.1%), 12.0 (33.3%), and 14.25 (39.6%), respectively. This indicates a difference between touch and vision of 4.5 (12.5%). The difference in the means between the two distance receptors here is 2.25 (6.3%). Thus, the use of the contact receptor, touch, is greater than the use of the two distance receptors for the autistic group on the pretest. Touch is most favoured, then audition, and least, vision. From Table 4 it may be observed that each autistic boy indicated a touch dominance. This table also shows that subjects 1 and 3 chose audition over

Table 4

Autistic Group Scores and Percentages across Modalities on the Pretest

Subject	Modalities: Touch		Audition		Vision	
1	17*	(47.2%)	13	(36.1%)	6	(16.7%)
2	18	(50.0%)	9	(25.0%)	9	(25.0%)
3	16	(44.4%)	14	(38.9%)	6	(16.7%)
4	14	(38.9%)	11	(30.6%)	11	(30.6%)
Total	65		47		32	
Mean	16.25	(45.0%)	11.75	(32.6%)	8.00	(22.2%)
SD	1.71		2.22		2.40	

*Maximum score per Modality = 24.

Table 5

Normal Group Scores and Percentages across Modalities on the Pretest

Subject	Modalities Touch	Audition	Vision
1	9*(25.0%)	10 (27.8%)	17 (47.2%)
2	7 (19.4%)	13 (36.1%)	16 (44.4%)
3	11 (30.6%)	12 (33.3%)	13 (36.1%)
4	12 (33.3%)	13 (36.1%)	11 (30.6%)
Total	39	48	57
Mean	9.75 (27.1%)	12.00 (33.3%)	14.25 (39.6%)
<u>SD</u>	2.2	1.4	2.7

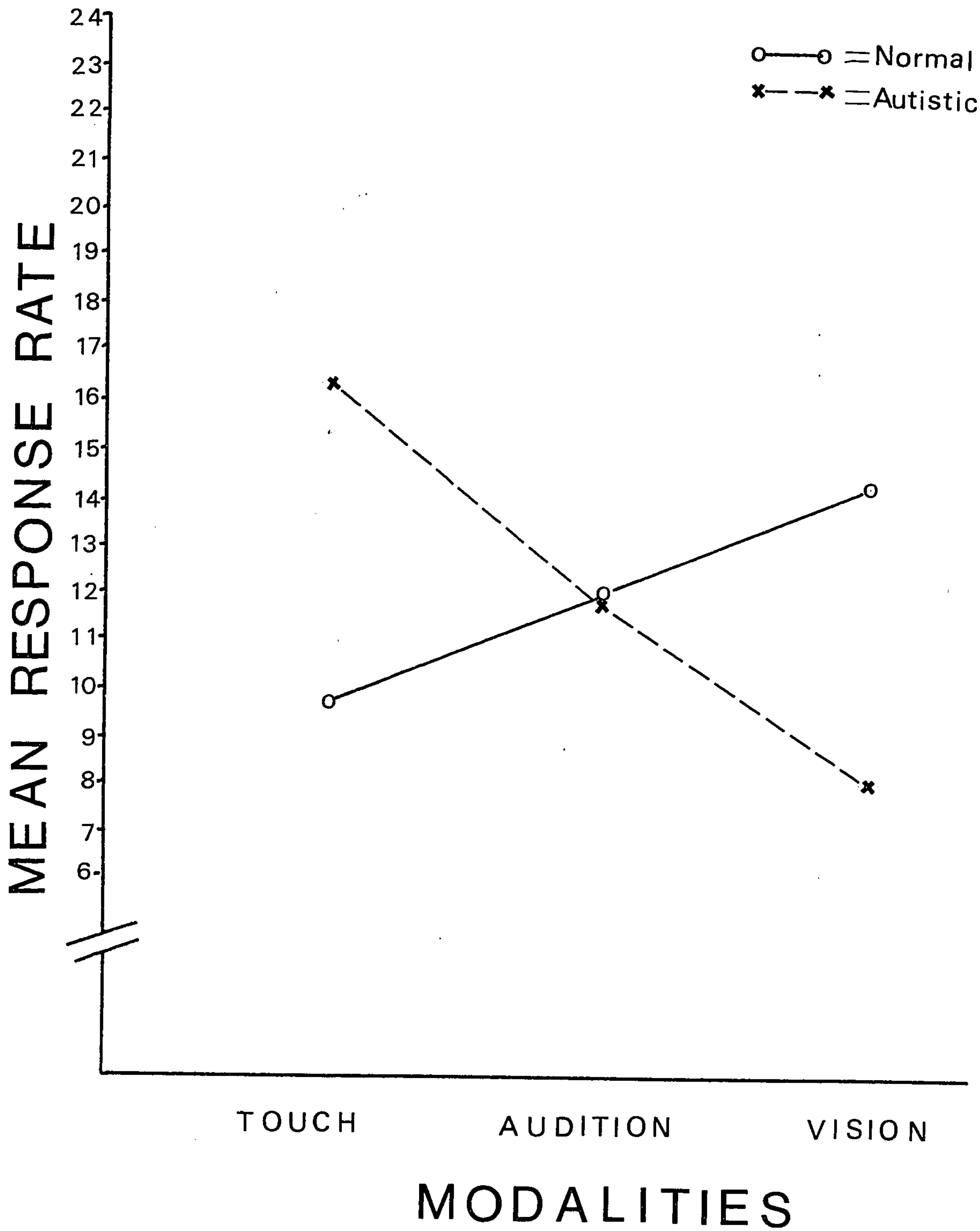

FIGURE 3. Mean Scores of Autistic and Normal Subjects on the Pretest.

vision, but subjects 2 and 4 gave equal attention to audition and vision. The normal control group, however, show a dominance of their distance receptors over their contact receptor, touch. Vision is highest, then audition, and least touch. Table 5 illustrates that touch is the least preferred modality for each normal subject and that only in the case of subject 4 is audition preferred over vision.

When the mean scores of audition and vision on the pretest are combined and averaged, this distance receptor composite is 9.9 (37.9%) for autistic subjects, and 13.1 (57.3%) for the normal control group. In the autistic subjects the difference is more pronounced between the contact receptor and the composite for the distance receptors, than is the case for the normal control group. The difference is 6.3 (24.1%) and 3.4 (14.8%), respectively. This relationship is expressed in Figure 4. From the criteria set in Chapter II, the results indicate that the contact receptor dominance for the autistic group is consistent for each subject in the group. In addition, the dominance is in the predicted direction and there is a moderately substantial difference between modalities. For the normal boys, the distance receptor dominance is consistent for each subject in the group and in the expected direction. The overall difference between chosen modalities is mildly substantial, certainly less than is the case for

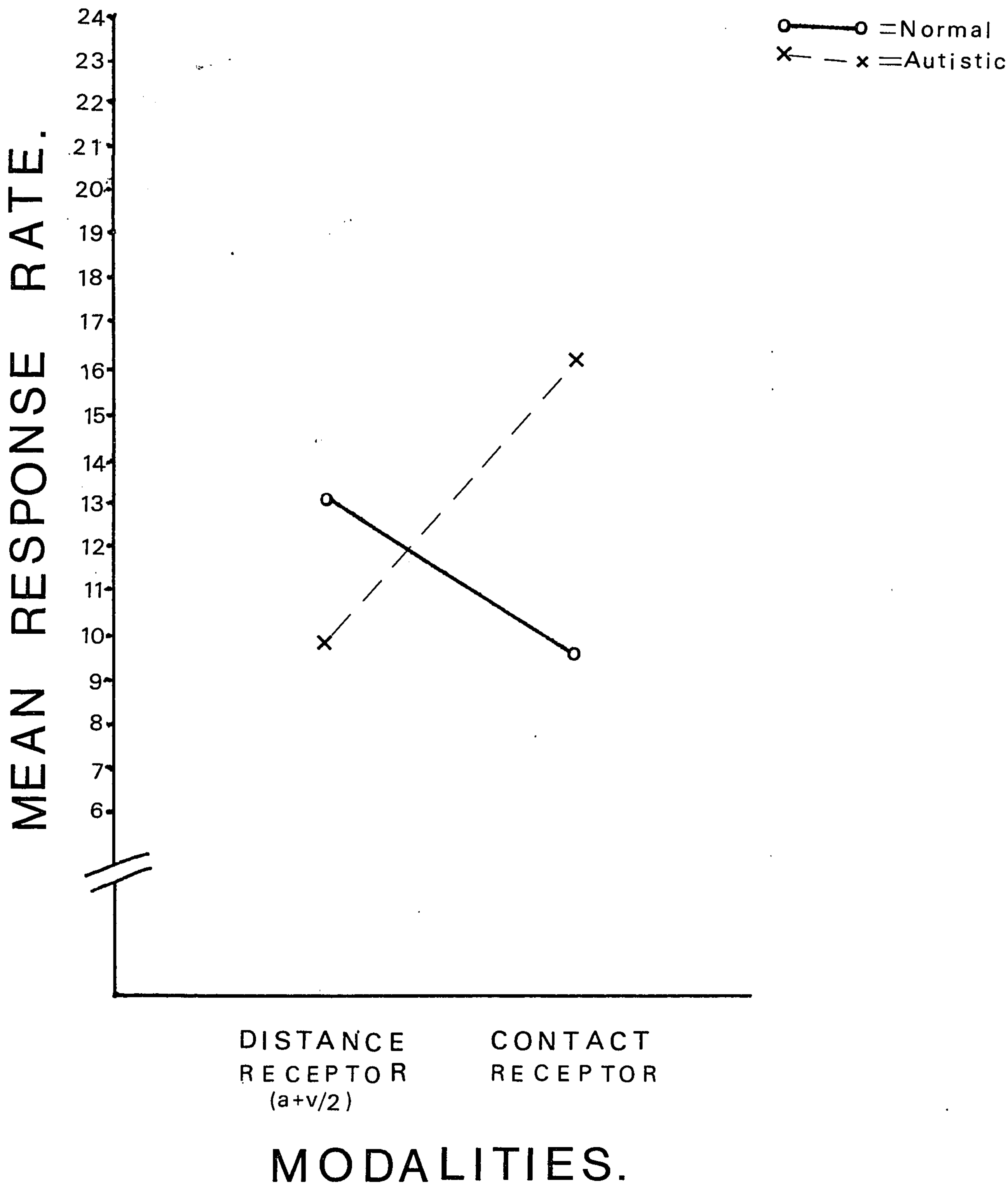

FIGURE 4. Combined Distance Receptor Mean Scores and Contact Receptor Score on Pretest.

the autistic group. On the basis of these results, there tends to be support for hypothesis 1 and hypothesis 2.

Part 2 - Pre-Posttesting Differences Following Training

This section will deal with theoretical hypotheses 3 to 6 pertaining to change in the treated autistic subjects in relation to the autistic and normal control groups. The pretest-posttest data for the autistic treated, autistic control, and normal control groups will be presented in Tables 6, 7, and 8, respectively. The text, however, will deal with each modality separately indicating the differences over times for the subject groups. Figures 5, 6, and 7 follow the organization of the text.

Within the modality of touch, the means for comparison between the pretest and the posttest for the treated autistic group are 17.5 (48.6%) and 13.5 (37.5%), respectively. This shows a decreased mean difference of 4.0 (11.1%). Table 6 indicates, in fact, that this 4 point decrease in touch receptor usage was the amount scored by both treated subjects. Also on the touch modality, the means for comparison in the autistic control group are 15.0 (41.7%) and 15.5 (43.0%) with a difference of 0.5 (1.3%) (see Table 7). Similarly, for the normal control group, the pre-posttest measures are 9.75 (27.1%) and

Table 6

Treated Autistic Group Scores and Percentages on Pre- and Posttesting

Subject	Modalities					
	Touch		Audition		Vision	
	Pre	Post	Pre	Post	Pre	Post
1	17(47.2%)	13(36.1%)	13(36.1%)	12(33.3%)	6(16.7%)	11(30.6%)
2	18(50.0%)	14(38.9%)	9(25.0%)	10(27.8%)	9(25.0%)	12(33.3%)
Total	35	27	22	22	15	23
Mean	17.5(48.6%)	13.5(37.5%)	11.0(30.6%)	11.0(30.6%)	7.5(20.8%)	11.5(31.9%)
SD	.7	.7	2.8	1.4	2.1	.7

Table 7

Autistic Control Group Scores and Percentages on Pre- and Posttesting

Subject	Modalities					
	Touch		Audition		Vision	
	Pre	Post	Pre	Post	Pre	Post
1	16(44.4%)	16(44.4%)	14(38.9%)	15(41.7%)	6(16.7%)	5(13.9%)
2	14(38.9%)	15(41.7%)	11(30.6%)	10(27.8%)	11(30.6%)	11(30.6%)
Total	30	31	25	25	17	16
Mean	15.0(41.7%)	15.5(43.0%)	12.5(34.7%)	12.5(34.7%)	8.5(23.6%)	8.0(22.2%)
SD	1.4	.7	2.1	3.5	3.5	3.2

9.25 (25.7%), also with a difference of .5 (1.3%) (see Table 8). Neither control group showed a difference for touch between pre- and posttesting of more than a half point. None of the autistic control or normal control subjects scored more than 1 point difference over the time period between the testings. The overall relationship between subject groups for touch is illustrated in Figure 5.

In the case of audition, the means for comparison in the autistic treated group are 11.0 and 11.0 (30.6%) (see Table 6). Both subjects scored a 1 point difference but in opposite directions between pre- and posttesting. In the autistic control group, the means were 12.5 and 12.5 (34.7%) (Table 7). Again, both subjects scored differently by 1 point between their testings but in the opposite directions. Receptor dominance for the normal control groups between pre- and posttest for audition also remained relatively unchanged: 12.0 (33.3%) and 12.75 (35.4%), respectively (see Table 8). The relationship between groups over time for audition appears in Figure 6.

Within the modality of vision, the contrasted means for the treated autistic group are 7.5 (20.8%) and 11.5 (31.9%), respectively (see Table 6). This is a mean increase of 4 points in visual dominance for the treated boys from their pretest scores. Table 6 shows that subject 1 increased by 5 points and subject 2 by 3 points. For this

Table 8

Normal Control Group Scores and Percentages
on Pre- and Posttesting

Subject	Modalities: Touch Pre	Touch Post	Audition Pre	Audition Post	Vision Pre	Vision Post
1	9(25.0%)	9(25.0%)	10(27.8%)	12(33.3%)	17(47.2%)	15(41.7%)
2	7(19.4%)	7(19.4%)	13(36.1%)	14(38.9%)	16(44.4%)	15(41.7%)
3	11(30.6%)	10(27.8%)	12(33.3%)	12(33.3%)	13(36.1%)	14(38.9%)
4	12(33.3%)	11(30.6%)	13(36.1%)	13(36.1%)	11(30.6%)	12(33.3%)
Total	39	37	48	51	57	56
Mean	9.75(27.1%)	9.25(25.7%)	12.00(33.3%)	12.75(35.4%)	14.25(39.6%)	14.00(38.9%)
SD	2.2	1.7	1.4	.9	2.7	1.4

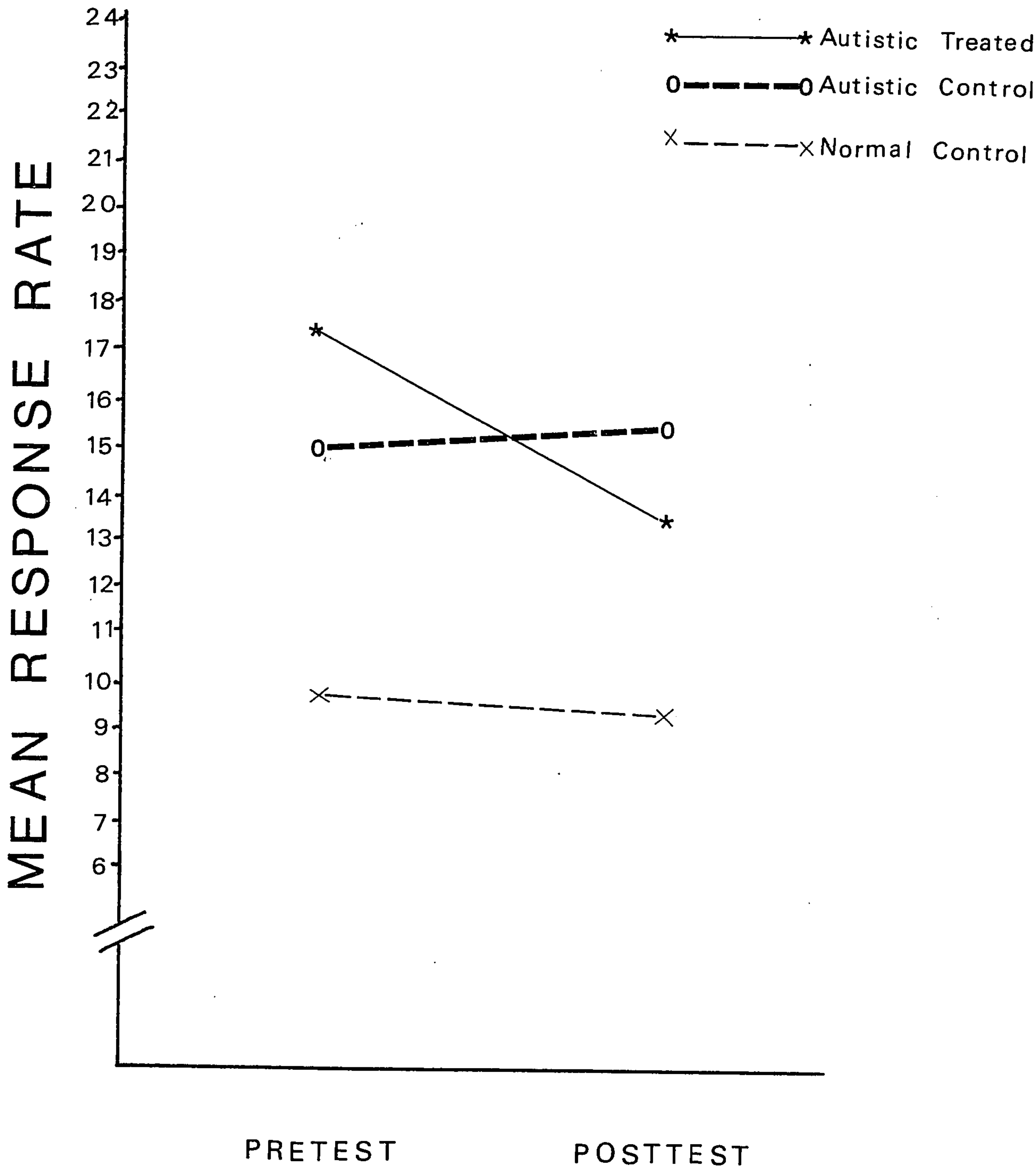

FIGURE 5. Mean Score Difference between Pretest and Posttest for Touch.

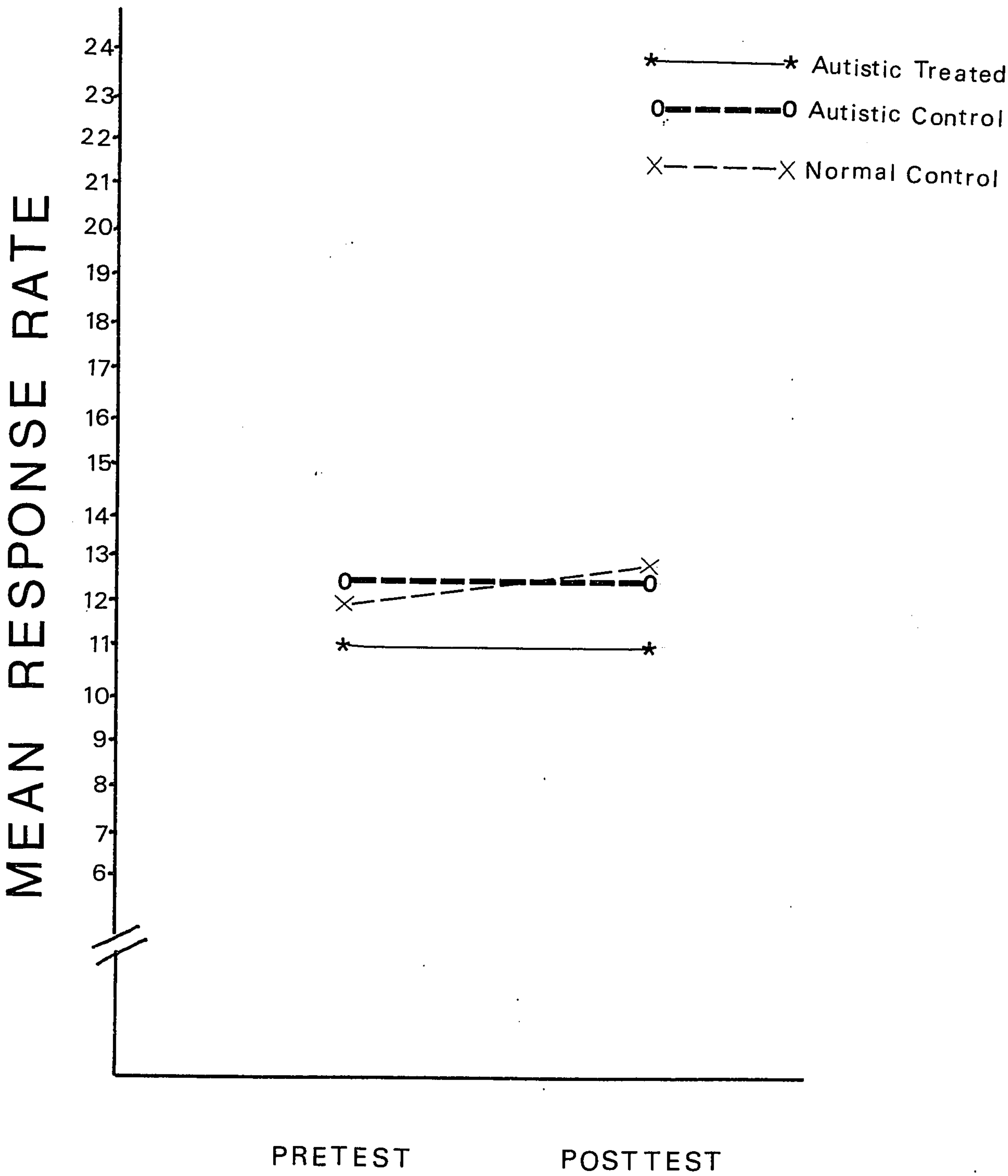

FIGURE 6. Mean Score Difference between Pretest and Posttest for Audition.

same modality, the means of the autistic control group are 8.5 (23.6%) and 8.0 (22.2%) between pre- and posttest measurement (Table 7). Subject 1 showed a 1 point difference and subject 2, no difference over time. Similarly, in the normal control group, the means for comparison are 14.25 (39.6%) and 14 (38.9%) (see Table 8). Within the normal control group, the individual scores varied only slightly. Subject group differences for vision are shown in Figure 7.

It is notable that there is a marked absence of any mean differences exceeding .75 between pretest and posttest measures for either the autistic control group or the normal control group on either touch, audition, or vision. Relating to hypotheses 3 and 4, there is little evidence of any substantial difference between pre- and posttesting for either the autistic control group (hypothesis 3) or the normal control group (hypothesis 4), on any modality. The consistency of the individual responses over time for the two autistic controls is illustrated in Figure 8. The same consistency for the four normal controls appears in Figure 9. From Figure 8 it can be observed that across the modalities, the lines for the pretest and the posttest are similar for both autistic control subjects. In the case of the normal control subjects illustrated in Figure 9, the pretest and

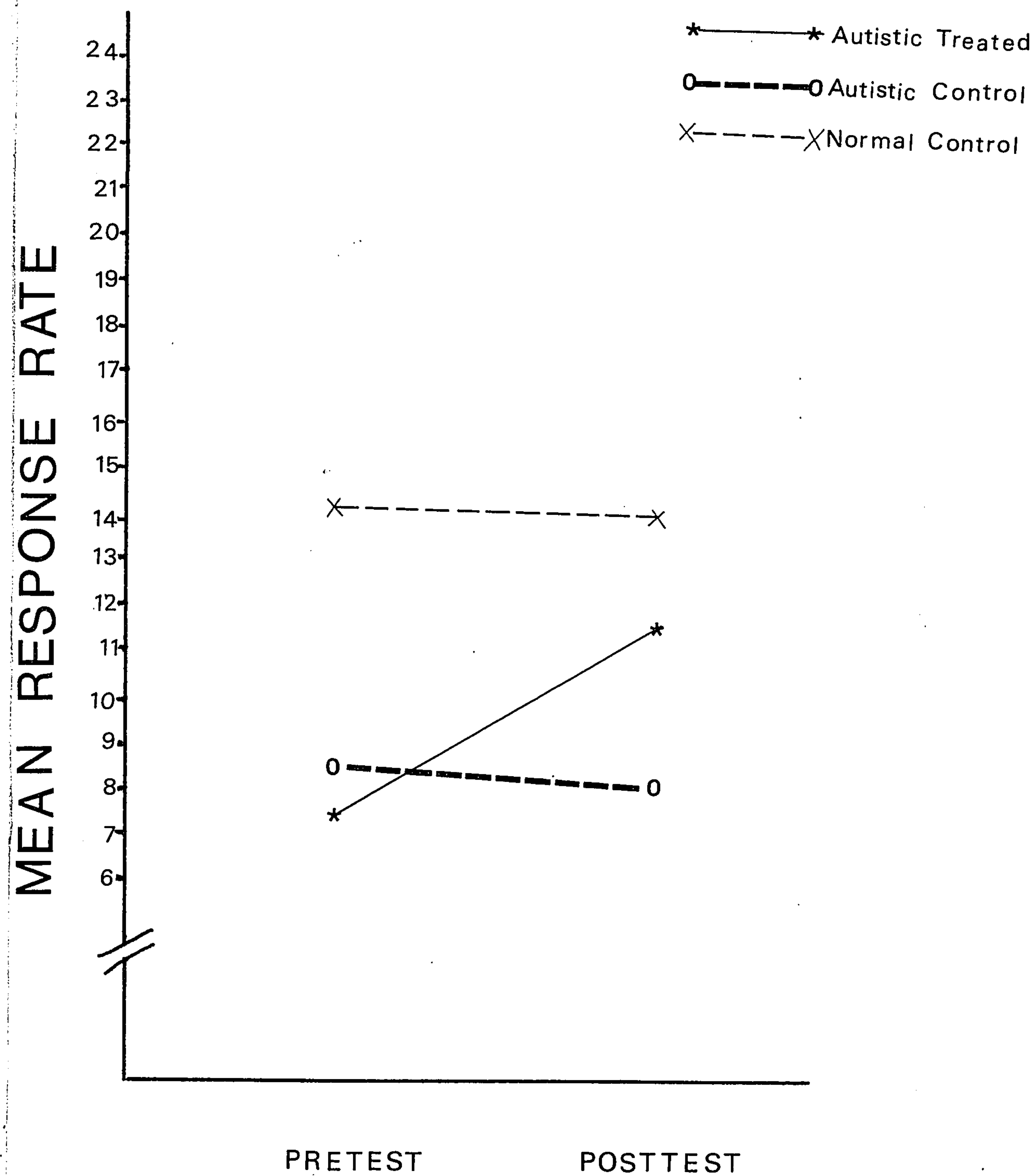

FIGURE 7. Mean Score Difference between Pretest and Posttest for Vision.

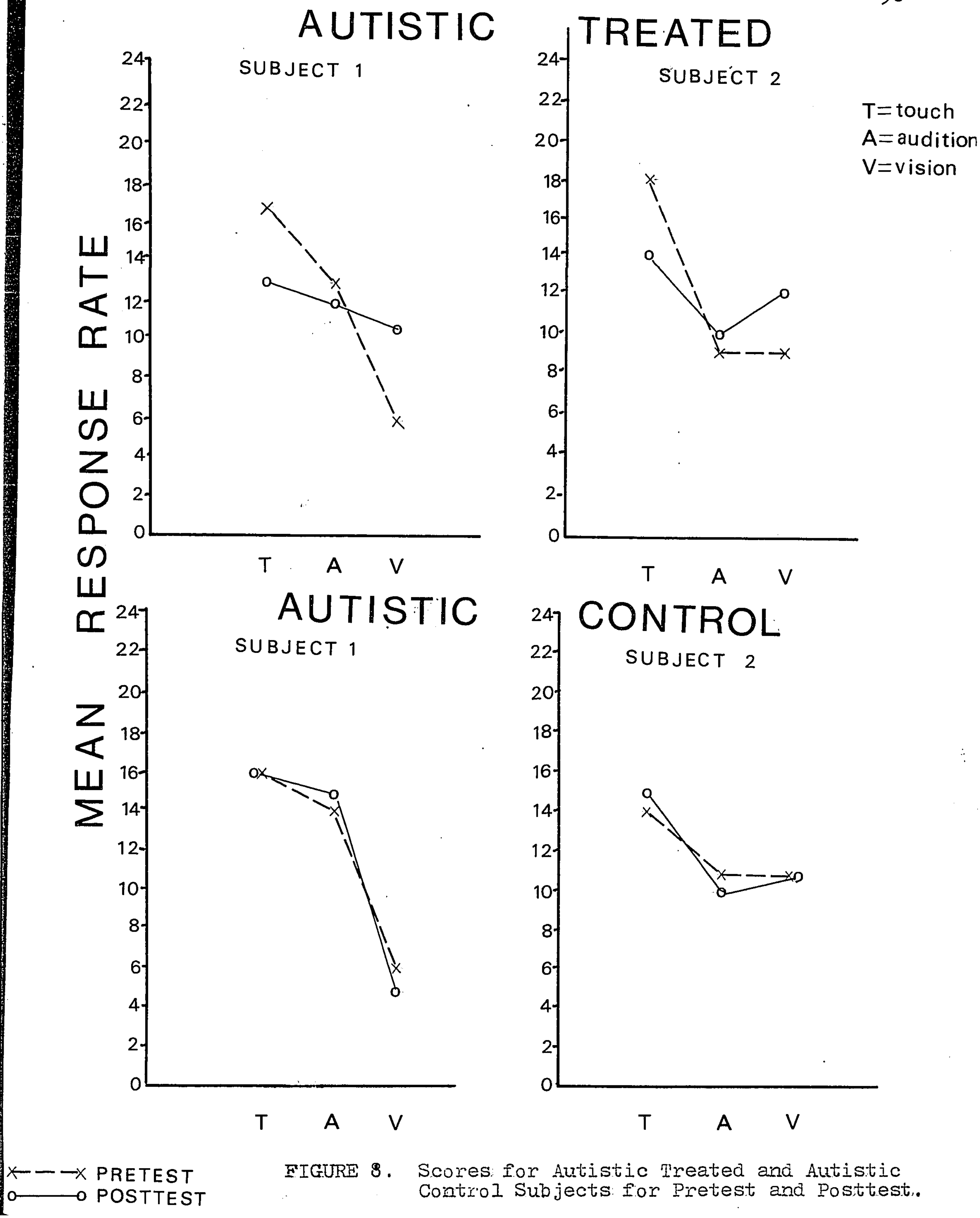

FIGURE 8. Scores for Autistic Treated and Autistic Control Subjects for Pretest and Posttest.

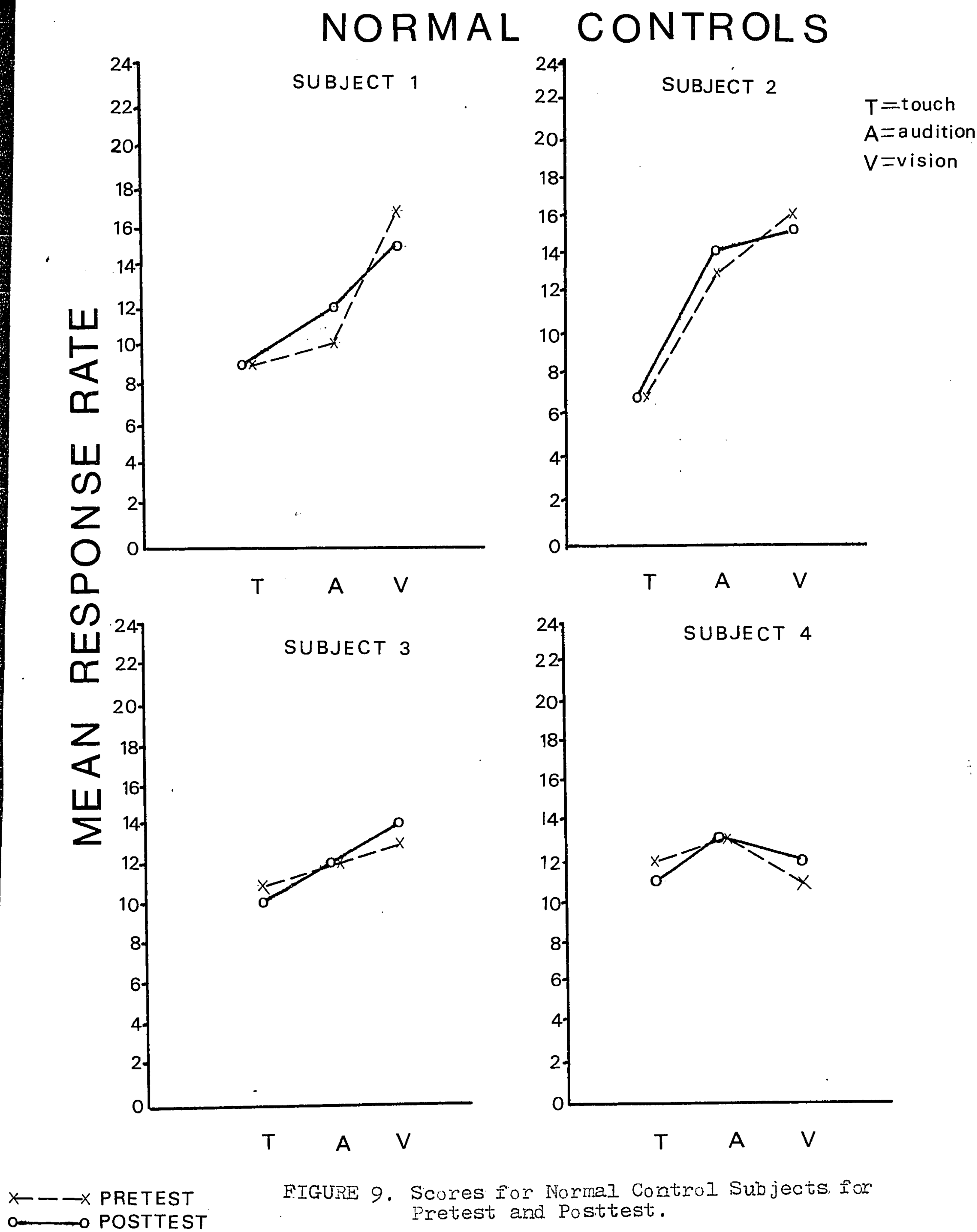

FIGURE 9. Scores for Normal Control Subjects for Pretest and Posttest.

posttest lines for subjects 2, 3, and 4 show a similar pattern across modalities. Subject 1, however, shows a reversal of audition and vision over time.

In considering all three groups, the largest differences are found in the autistic treatment group where there is a decrease from pre- to posttesting in the touch modality and an increase for vision. These changes for touch and vision are consistent for both autistic treated subjects, as can be seen in Figure 8. Hypothesis 5 predicted that there would be a substantial difference between pre- and posttesting for either touch, audition, or vision. The results show that the differences for touch and vision are substantially greater than the fluctuations occurring for either the autistic or normal control groups. It should, however, be noted that for audition there is no substantial difference in relation to the fluctuations observed for the two control groups. With reference to the predicted direction of change stated in hypothesis 6, the treated autistic group shifted their receptor dominance in the direction of a contact (touch) receptor decrease..

CHAPTER IV

DISCUSSION

This chapter will be divided into two sections: The first will attempt to discuss the results presented in Chapter II with reference to the six theoretical hypotheses and the criteria set down in Chapter II to evaluate them. The second section will look at the clinical implications of the findings in relation to the management and treatment of autistic children.

Discussion of Results

The results presented in Part 1 of Chapter III demonstrate that the four autistic boys displayed a contact receptor dominance over their distance receptors and the normal group, a distance receptor dominance over their contact receptors. It has been shown that, when evaluated according to the criteria set in Chapter II, both groups manifested subject consistency and direction of expected dominance. The third criterion, that of the magnitude of the difference between contact and distance receptors, was predicted to be different between the normal and autistic groups. The experimental results obtained show that the autistic group did, in fact, manifest a more substantial difference between modalities than did the normal group.

The reason for this expected difference between groups was mentioned in Chapter II in the context of the criteria for evaluation, but can be discussed now in the light of the results obtained. As suggested earlier, one would expect a distance receptor dominance in the normal group, but not to the extent of the extreme differences shown due to pathological functioning. The autistic contact receptor dominance found in this study is seen as due to a defective organization in functioning rather than a mere regression to an infantile level of activity. Where the autistic child manifests a distance receptor avoidance, normal receptor dominance appears to produce a pattern of functioning whereby the modalities of touch, audition, and vision are more closely integrated in their usage. The normal child, therefore, does not develop a contact receptor avoidance. Such a child has developed beyond the stage when most of his exploration and learning is in near-space. Stimuli impinging upon the distance receptors do not represent the same source of threat or confusion for the normal group as they do for the autistic.

A further central feature of the pretest results is the lack of differentiation between autistic and normal groups on their auditory modality. According to the rationale for the division between contact and distance receptors and the classification of audition as a distance receptor, one would expect a larger difference between the subject groups on the pretest than the 0.25 found. In addition to this theoretical inconsistency, these findings are incongruent with the reaction frequently observed in autistic children of startle and abnormal hypersensitivity to sound (Delacato, 1974; Schopler, 1965). There are various possible contributing factors which may make this result more comprehensible. In testing the equipment after construction, it was found that the autistic children were startled by the auditory stimulus in its initial form and mode of presentation. This consisted of two buzzers mounted on the two side "wing" panels so that the sound originated from behind the testing consol. Both the sound stimulus and its source were tested separately and it was found that only if the "buzzer" was changed to a "tone" and the consol mounting changed to headphones, could the child cope and not react in such a manner that would make testing impossible. In addition to this, there was also a familiarization period prior to testing which further diminished the adverse reaction. In retrospect, it is possible that these adaptations of equipment and procedure may have made the test stimulus not strong enough to bring out differences in the autistic group. In other words, these modifications may have changed the nature of the auditory stimulus and thereby reduced the threat that usually accompanies these stimuli in an open-environment situation. A further possible explanation is that the use of the headphones brought the stimulus into near-space wherein the autistic child functions best. The black testing panel may have also served to reduce the effect of distraction and this may not have been as important an influence on the normal children's performance as on the performance of the autistic children. The implications that these effects may have had in general on the results are that the auditory stimuli employed were perhaps not optimally representative of the auditory environment with which the autist must characteristically cope. Nonetheless, the results show that the autistic boys still preferred touch over audition even in the form employed.

The pretest results obtained tend to support the theoretical position of a developmental sequence of sensory dominance as proposed by Jones and Hart (1968). The reservations concerning the validity of the auditory stimulus, however, suggest that the sequence should be interpreted with some caution. According to Jones and Hart, visual dominance and organization lies at the most complex end of the sequence with audition between touch and vision. The largest differences for both the autistic and normal subject groups obtained for the touch and visual modalities support this sequence of receptor dominance.

The pretest results also support the experimental findings of Schopler (1966) that when the autistic and normal child are offered a choice of objects which have predominantly visual or tactile properties, the autist tends to choose the tactile and the normal child prefers the visual. The results also support the study by Hermelin and O'Connor (1970) when they compared normal and autistic children on a tracking task with and without the aid of visual cues. Where the normal children used this to improve their performance, the autistic children chose to continue almost exclusively in the tactile modality.

The second part of the results indicate that according to the criteria set for evaluating change over the 5-month training period, there was a substantial difference between the pretest and posttest scores for the two treated autistic boys. The change in this group occurred in the two modalities of touch and vision, but the training had no effect on the level of auditory functioning. The decrease in touch dominance and concomitant increase in visual dominance found in the treated autistic subjects may be interpreted as a change in their receptor dominance as a consequence of training. It is significant that the direction of the change in dominance is towards the pattern of functioning scored by the normal boys and away from that of the autistic control subjects.

Further evidence for the developmental sequence proposed by Jones and Hart (1968), as well as the hypothesis of a contact receptor dominance, comes from the application of the training program. Both treated boys passed relatively easily over the gustatory, olfactory, kinesthetic, and tactile exercises but found the greatest difficulty with the exercise tasks involving body-awareness and as much time as this took to accomplish even more difficult was the stage of spatial-awareness. This is, according to Jones and Hart, the particular time when dominance shifts from mid- to far-space and when the child develops from primarily contact receptor usage to the distance receptors (Schopler, 1965).

The similarity of the scores for audition in the treated boys before and after training may be explained in different ways. This finding may be a reflection of the nature of the auditory stimulus employed in this research which was discussed earlier. One may argue that because the measure is not representative of the autistic child's relationship to auditory stimuli generally, any change effected by the training program would not be accurately measured on the equipment in the form of the auditory stimulus presented. The reason for this is that the child will respond after training to the "desensitized" auditory stimulus in the same unthreatened manner as existed for him in the pretest. An alternate explanation of this finding is more theoretical and relates to the notion that the sequence of development proceeds from touch through audition to vision. If it can be assumed that the auditory stimulus used had some wider relevance, although not optimal, to auditory receptor usage in other less structured environments, then one might argue that any change due to the training would affect the more extreme modalities before any effect is produced on a modality in a less distal position. There is wide agreement that vision is more of a truly "distance" receptor than is audition. Vision is perhaps more sensitive to change than is audition and is affected before the latter modality. There is some evidence that the tactile modality has a more direct influence on the visual system than on the auditory system. Melzack, Konrad, and Dubovsky (1969) found that after the paw of a cat was rubbed for some time, the changes in electrical activity at several levels of the visual system lasted more than twice as long as those in the auditory system.

The lack of any substantial difference over the 5-month period for either the two untreated autistic boys or the four normal controls on either touch, audition, or vision points to the reliability of the bimodal method of assessment. This consistency over time is remarkable by itself and serves to highlight the change in the treated boys.

The pretest results of a contact receptor dominance are consistent with the theories of reticular damage discussed in Chapter I. The child who suffers random fluctuations of arousal (Ornitz & Ritvo, 1969), or who has difficulty relating incoming stimuli to past experience (Rimland, 1964) will be restricted to a simpler, more concrete level of receptor functioning. The posttest results suggest, however, that one should be careful not to overstress neurological impairment in the perceptual functioning in autism. If the 5-month program facilitated a change in dominance, the hypothesis of reticular damage needs to be reconsidered. This, however, does not completely exclude the possibility of organic damage with an overlay of psychogenic involvement. The implications of such an involvement may be that parents and teachers, when autism is diagnosed, could provide the structure required to explore a controlled environment in such a way that the modalities employed by the child are planned according to the problems he may be experiencing along the sequence of development.

A major limitation in this study is the restriction on the number of autistic children available. Of the 22 pupils at the School for Autistic Children, the four boys were the eldest in the school. The other children were mainly in the 4- to 8-year-old range. A more ideal sample size would have been six to eight children per group. It might also be more desirable to employ younger autistic children who are sufficiently verbal to be tested. A possible further limitation of the results is the fact that all subjects were male. Although it is agreed that every caution should be observed in this regard, no reason is known why receptor dominance is inapplicable to female autistic children. In fact, many of the cases reported in the literature manifesting impaired perceptual activity are female. It may be recalled from Chapter I that the incidence of autistic males to females is 4.5 to 1 which places even further restrictions on available female subjects.

During the testing, it may have occurred that a response-set developed; for example, where the child always pointed to the left or alternated between left and right. As each of the stimuli occurred with equal frequency on either side, an equal distribution of scores would thus have resulted over modalities. No score of any child approached such a pattern or indicated the occurrence of any response-set.

It is not known which aspect of the program was shown to be effective: body-image training, sensory discrimination, directionality, or the other exercises. If the child's resistance, time allocated, and the effort involved in training could be an indication of the source of the change, the part of the program that received most attention was the shift in emphasis from contact to distance receptors.

The child was allowed to proceed at his own pace and the therapist was sensitive to the danger of moving too quickly. An important hazard in receptor dominance training is sensory overload. If the amount of input is so great that the child is unable to respond successfully, his behaviour might break down and the integrative effects of the training be attenuated. The signs of overload are hyperexcitement that is not calmed for some time after a session. A balance of freedom and structure that maximizes constructive exploration is not easily achieved. Both contribute to the training situation and different children require varying degrees of each. Free play does not inevitably, by itself, further sensory integration, but too rigid a structure is inhibiting. The structure in the program can help push the child further towards the training objective than he could reach alone.

Other changes were noted in both the treated autistic boys by their teachers. One boy was described as "more attentive in class" and as being less distracted by environmental sounds from outside the classroom. Another area of marked improvement was in his tolerance for certain foods which he had previously rejected for no apparent reason and without any consistency. The second subject was reported as having become "less sensitive to certain types of light such as mirrors" and better able to "tolerate intrusion from other people." The mother of this boy commented a month after the termination of training that she had noticed less problems of daily management and less extremes in his behaviour during the 5-month period. She had noticed also some decline since the termination of training.

Clinical Implications

The rise of behaviour therapy produced a decrease in the tendency to propose broad theories concerning the etiology of a disorder and promoted an emphasis on treatment and the small experiment. The field of autism has followed in this trend and since the 1960's there has been an increased emphasis on treatment. These studies are largely from a behavioural perspective from such workers as Lovaas et al. (1965) and employ learning principles to modify autistic behaviour. It is surprising that more research has not been undertaken which focuses on sensory stimulation in treatment when one considers the central role that abnormal perceptual experience plays in autism.

Prognosis for the treatment of autism would possibly be considerably improved with earlier detection. More information is needed concerning the relationship between infant sensitivity and stimulation with reference to critical periods for stimulation, types of stimulation, and the effect on development. If sensitivity norms could be established from research, an autistic direction may be predictable from a relative hypo- or hypersensitivity. When more is known also of the age norms for growth onto each of the six modality functions (G-O-T-K-A-V), this may also be of use in early detection. If corrective training in receptor activity can produce change, then together with information concerning detection, this could help pediatricians and parents responsible for the care of young autistic children.

If the contact receptor dominance in autistic children can be changed to more effective functioning with training, then a new approach needs to be taken in the teaching of these children. The demands on the autist to learn to read and write should be preceded by a program designed to allow him to explore and experience with different modalities in a structured setting.

This study in both the testing and training phases has emphasized that in order to help the autistic child to concentrate and to minimize the abnormal reaction to various stimuli, he can be taught in a room which is designed to reduce distraction. Such a sound-absorbing environment might include rugs, curtains, and an acoustic-tile ceiling. The child does best also in a subdued visual environment with indirect lighting and no distracting wall colours, wall-paper, or pictures. There is some controversy, however, as to the extent to which these children should be protected in this way. Perhaps the best approach is to teach the autistic child with a minimum of distractions, but also to be aware of opportunities for a progressive introduction of new stimuli. One potentially useful finding that emerged from the testing situation was that the child could be trained not to react to a stimulus with startle by allowing him to become acquainted with and control the stimulus. A possible use of this may be if a child reacts to sound from an intercom with panic, he may be permitted to play with the volume control, adjusting the sound level himself. With this degree of control, the child is better able to locate its source in space, and to adjust to it. It has been frequently observed (Kugelmass, 1970; Wing, 1966) that the autistic child is able to tolerate any amount of noise that he himself initiates and reacts only to the intrusion of those stimuli which are out of his control.

The adverse reaction to certain stimuli appears to be the result of overwhelmingly complex sensory input from near-, mid-, and far-space. The autistic child faced with this vast amount of information is more confused by than unaware of stimuli from far-space. The usage of his distance receptors reflects an active avoidance rather than unaware inattention.

He thus reacts adversely to intrusion when demands are made of him to use those modalities which most confuse him. Receptor dominance training aims at providing the child with the opportunity to become acquainted with information from all levels of the space around him.

In future research, more use could be made of established forms of clinical assessment. External criteria could add construct validity to both the training program and the bimodal form of measuring receptor dominance. As mentioned earlier, future research should employ younger children of both sexes and include larger groups. Both the method of testing and the training program need to be validated against other criteria and standardized with different populations.

This study has been both interesting to carry out and gratifying in the results obtained. In conducting research within this relatively new area, it is hoped that it shall serve as a step towards a more detailed examination of contact receptor dominance in autism which may open a new avenue for treatment.

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APPENDIX 1

CASE PROFILES OF AUTISTIC BOYS

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<u>A1 (R.Z.) 12 years 11 months</u>

A thin boy with pale complexion and large, brown eyes. The younger of two sons whose parents were wealthy and well educated. He had been severely withdrawn as a young child when he arrived at the school at the age of four with a lack of social responsiveness and primitive motor behaviour. He was much improved but retained an obsessive interest in mechanical objects and became completely preoccupied with spinning objects. He would often react excessively to stimuli and throw a tantrum when frustrated. He avoided contact when possible, but when distractions were minimal, his contact improved. He showed an insistence on sameness and became upset if "his" special crockery and cutlery were not used. Also evident were poor and irregular sleeping patterns. His speech, memory, and imagination were good.

<u>A2 (G.B.) 11 years 11 months</u>

A large, heavily built boy who was the youngest of four children. He frequently surprised his teachers by indicating that he understood more than was the impression given by his verbalizing. A small stress would often lead to anxiety attacks. He was very insecure and needed constant reassurement. When particularly anxious he would use echolalic language of the delayed type repeating sentences he had heard days before. If annoyed by another child he would become enraged, but then become afraid. In open spaces he would become hypersensitive, anxious and irritable. He was extraordinarily sensitive to sound and could often hear an approaching siren before anyone around him.

<u>A3 (R.C.) 11 years 3 months</u>

A small, attractive boy with blue eyes who was an only child. He was highly distractable, restless, and impulsive, and would flap his hands, circle on tiptoe, and lunge forward when excited. His speech was good but exhibited occasional echolalia. He had to be kept away from small animals as he would injure them. He showed negativism and withdrew when demands were made of him. Unpredictable sounds were often reacted to with a tantrum; he frequently destroyed telephones and intercoms. He was also sensitive to certain tastes that he would not eat nor allow near him. On occasion, he manifested self-mutilatory behaviour such as headbanging.

A4 (R.T.) 11 years 1 month

A blonde boy, the elder of two siblings. He was withdrawn, preoccupied and appeared aloof. He never became really familiar with anyone and would refer to everyone by both their names. He had a limited social repertoire of phrases and commonly used a telegraphic form of speech when excited. At these times he would flap his hands and make small jumping movements. Frequently, he showed limited ability to delay gratification. At times he would tease another boy and this would excite him very much; what followed from this were periods of bizarre posturing and talking to himself. He had an unregulated eating and sleeping pattern. When out of doors for a long period, he would close his eyes and rock himself.

APPENDIX 2

AN EXAMPLE OF A RAW SCORE SHEET USED FOR ALL NORMAL AND AUTISTIC SUBJECTS ON THE PRETEST AND POSTTEST

SCORE SHEET.

SUBJECT N.4.................. AGE ....11 5/12...............

DATE .... TIME ....11.45 am.............

A. TRAINING.				PRE/~~POST~~
	1.	LV	....✓..........	
	2.	RV	....✓..........	
	3.	LA	....✓..........	
	4.	RA	....✓..........	
	5.	LT	....✓..........	
	6.	RT	....✓..........	
	7.	RA	....✓..........	
	8.	RV	....✓..........	
	9.	LT	....✓..........	
	10.	RA	....✓..........	
	11.	LA	....✓..........	
	12.	LV	....✓..........	
	13.	RT	....✓..........	
	14.	RV	....✓..........	
	15.	LV	....✓..........	
	16.	LA	....✓..........	
	17.	RT	....✓..........	
	18.	LT	....✓..........	

LEFT L

RIGHT R

TACTILE T

VISUAL V

AUDITORY A

TOTAL ..18../18

CRITERION MET: YES/~~NO~~

FURTHER TRAING: ...–....

B. TEST OF RECEPTOR PREFERENCE:

1.	LA ✓	RV	19.	LV	RA ✓
2.	LT	RV ✓	20.	LA ✓	RV .....
3.	LA	RT ✓	21.	LT ✓	RV .....
4.	LV ✓	RA	22.	LT	RA ✓
5.	LV	RT ✓	23.	LA ✓	RT .....
6.	LT	RA ✓	24.	LV ✓	RT .....
7.	LT	RV ✓	25.	LT	RA ✓
8.	LV ✓	RA	26.	LA	RT ✓
9.	LT	RA ✓	27.	LV	RT ✓
10.	LV	RT ✓	28.	LA	RV ✓
11.	LA ✓	RV	29.	LV ✓	RA .....
12.	LA	RT ✓	30.	LT	RV ✓
13.	LV	RT ✓	31.	LA ✓	RT .....
14.	LT	RA ✓	32.	LV	RT ✓
15.	LA ✓	RV	33.	LV ✓	RA .....
16.	LA	RT ✓	34.	LT ✓	RV .....
17.	LT	RV ✓	35.	LT ✓	RA .....
18.	LV	RA ✓	36.	LA	RV ✓

T	12/24	V	11/24	A	13/24

APPENDIX 3

STATISTICAL ANALYSIS OF RESULTS

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STATISTICAL ANALYSIS OF RESULTS

The data presented in this section will make reference to the tables and figures used in Chapter III. In this statistical treatment of the data, a similar subdivision will be used as in Chapter III between Part 1, referring to pretest receptor dominances, and Part 2, the effects of the training program on dominance.

Part 1

In the results pertaining to pretest measures, one can observe the trend across the modalities for the autistic and normal groups on inspection of the data in Table 4. Within a parametric analysis, in order to analyze the variance between modalities for the four autistic and four normal boys, an Analysis of Variance with Repeated Measures was undertaken and followed by a Scheffé Test of Multiple Comparisons. Table A shows the significance testing for the autistic group and Table B, the normal group.

In the case of the autistic subjects, the F ratio is 9.87 at the .05 level which is a significant difference between the three modalities. The Scheffé testing set out in Table A shows no significant difference between touch and

Table A

Summary of Analysis of Variance with Scheffé Comparisons on Autistic Subjects to Compare Sensory Modalities

Source	*df*	*MS*	*F*
Subject	3	0.00	0.00
A	2	68.25	9.87*
Error	6	6.92	

*$p < .05$

Modalities	Means for Comparison		*df*	*F*
Touch/Audition	16.25	11.75	2	2.93
Audition/Vision	11.75	8.00	2	2.03
Touch/Vision	16.25	8.00	2	9.84*
Contact/Distance Receptors	16.25	9.90	2	7.83

*$p < .05$

Table B

Summary of Analysis of Variance with Scheffé Comparisons on Normal Subjects to Compare Sensory Modalities

Source	df	MS	F
Subject	3	0.00	0.00
A	2	20.25	2.79
Error	6	7.25	

Modalities	Means for Comparison		df	F
Touch/Audition	9.75	12.00	2	.69
Audition/Vision	12.00	14.25	2	.69
Touch/Vision	9.75	14.25	2	2.79
Contact/Distance Receptors	9.76	13.12	2	2.09

audition, or between audition and vision at the .05 level. There is, however, a significant difference between touch and vision at the .05 level (F = 9.84). For the normal subjects (see Table B), the Analysis of Variance between modalities gives an F ratio of 2.79 which is not significant at the .05 level. The Scheffé comparison between individual modalities, also in Table B, shows a nonsignificant difference between touch and audition, audition and vision, and touch and vision at the .05 level. It can, however, be noted that the F ratio between touch and vision is the largest of the three contrasts: 2.79 (touch/vision); 0.69 (audition/vision); and 0.69 (touch/audition).

Table A shows that for the autistic group, when the two means of the distance receptors are combined to form a composite (9.9) and contrasted with the contact receptor (16.25), the difference is significant at the 5% level (F = 7.83). A nonsignificant difference is, however, found at the same level of confidence for the normal group (see Table B), where the means for comparison are 9.76 (contact) and 13.12 (distance) (F = 2.09). These results indicate a significant contact receptor dominance in the autistic group at the .05 level. A significant difference was not found between contact and distance receptors in the normal group.

Part 2

This section of the results concerns the effects of training on receptor dominance in the two treated boys in relation to the normal and autistic control groups. Table 6 in Chapter III shows the differences across touch, audition, and vision between the pre- and posttests for the treated autistic group. These differences for the modalities over time are presented in Table 7 for the autistic control group, and in Table 8 for the normal control group.

Table C shows the Analysis of Variance with Repeated Measures on B (modality) and C (pre-posttest). From these data it can be observed that there is a significant interaction between AB (subjects and modalities), BC (modalities and pre-posttests) and an overall significant interaction between ABC at the .05 level. In order to analyze these interactions further, a Simple Main Effects Test was carried out (see Tables D and E). In Table D the differences between pretest and posttest for the different subject groups and modalities are considered. These results indicate that there is no significant difference at the 5% level between pretest and posttest measures for the normal control group (A1) for either touch ($F(3,10) = .51$), audition ($F(3,10) = 1.16$), or vision ($F(3,10) = .13$). A similar nonsignificance is shown between pre- and posttest scores for the autistic

Table C

Summary of Analysis of Variance with Repeated Measures on Modality (B) and Pre-Posttest (C)

Source	*df*	*MS*	*F*
A	2	0.00	0.00
B	2	28.07	2.37
AB	4	52.30	4.42*
BC	2	5.42	6.20*
ABC	4	7.30	8.34*
B X SWG	10	11.82	
BC X SWG	10	0.87	

*p < .05

Table D

Simple Main Effects for Difference between Pretest(C1) and Posttest(C2) for Each Modality(B) and Subject Groups(A)

	df	MS	F
Normal controls			
**C at A1 (Normal) B1 (touch)	3	.30	.51
C at A1 (Normal) B2 (audition)	3	.67	1.16
C at A1 (Normal) B3 (vision)	3	.01	.13
Autistic controls			
C at A2 (Aut.Cont.) B1 (touch)	1	.30	.51
C at A2 (Aut.Cont.) B2 (audition)	1	.00	.00
C at A2 (Aut.Cont.) B3 (vision)	1	.30	.51
Autistic treated			
C at A3 (Aut.Treated) B1 (touch)	1	19.20	32.90*
C at A3 (Aut.Treated) B2 (audition)	1	.00	.00
C at A3 (Aut.Treated) B3 (vision)	1	19.20	32.90*
Error	10	.58	

*$p < .05$

**Note. C is the difference between C1 (pretest) and C2 (posttest).

control group (A2) for either touch ($\underline{F}(1,10) = .51$), audition ($\underline{F}(1,10) = .00$), or vision ($\underline{F}(1,10) = .51$. In the case of the treated autistic subjects (A3), a different pattern emerges. The difference between pre- and posttest measures for touch is significant, $\underline{F}(1,10) = 39.9$. The audition modality indicates a nonsignificant difference ($\underline{F}(1,10) = .00$). For vision, there is a significant difference at the .05 level with $\underline{F}(1,10) = 32.9$. These results suggest that there is no significant difference between pre- and posttest scores in either the autistic control group or normal control group for any of the three modalities. With the treated autistic group there is a significant difference for touch and vision, but not for audition. This suggests that the effects of the training program produced a significant change in touch and visual dominance.

In examining the direction of the change, Table E indicates another aspect of the Simple Main Effects Test. It can be observed here that there is a significant difference between the three subject groups (A) for touch on both the pretest and the posttest. On the pretest, however, the difference is at the .01 level of significance ($\underline{F}(2,11) = 7.4$) and on the posttest at the .05 level ($\underline{F}(2,11) = 4.8$). In the case of audition, there is no difference across the

Table E

Simple Main Effects across Subject Groups(A) for Each Modality(B) for Both Pre- and Posttests(C)

	df	MS	F
A at B1 (touch) C1 (pre)	2	37.55	7.40**
A at B1 (touch) C2 (post)	2	24.45	4.80*
A at B2 (audit.) C1 (pre)	2	1.40	.28
A at B2 (audit.) C2 (post)	2	2.10	.42
A at B3 (vision) C1 (pre)	2	31.80	6.30*
A at B3 (vision) C2 (post)	2	21.80	4.30*
Error	11	5.08	

*$p < .05$

**$p < .01$

subject groups on either the pre- or posttests. The *F* ratios are .28 and .42, respectively. For vision, although the differences across the subject groups are both significant at the .05 level, it may be noted that the *F* ratio decreases from 6.3 on the pretest to 4.3 on the posttest.

A Scheffé Multiple Comparisons Test testing the significance between each subject group on all modalities was then undertaken (see Table F). Although all differences between subject groups are shown, only those relevant to the direction of the training effect will be described. That is, those differences which relate to a reduction in contact receptor dominance in the treated boys. For the touch modality (pretest), the means for comparison between the normal control group and the treated autistic group are 9.75 and 17.5, respectively. This difference is significant at the .05 level, $F(2,2) = 22.35$. On the same modality, but on the posttest, the means for comparison are 9.25 (normal control) and 13.5 (autistic treated). This is not a significant difference and the *F* ratio is reduced to 13.8. It can be concluded that where a significant difference in contact dominance existed between the treated autistic group and the normal controls on the pretest, this difference became reduced after training.

Table F

Scheffé Multiple Comparisons across Subject Groups(A) for Each Modality(B) for Both Pre- and Posttest(C)

Modality	Means for Comparison		df	F
Touch (Pretest)				
	9.75-15.0	(Norm.Cont/Aut.Cont)	2	10.25
	15.00-17.5	(Aut.Cont/Aut.Treat)	2	1.74
	9.75-17.5	(Norm.Cont/Aut.Treat)	2	22.35*
Touch (Posttest)				
	9.25-15.5	(Norm.Cont/Aut.Cont)	2	14.74
	15.50-13.5	(Aut.Cont/Aut.Treat)	2	2.28
	9.25-13.5	(Norm.Cont/Aut.Treat)	2	13.76
Audition (Pretest)				
	12.00-12.5	(Norm.Cont/Aut.Cont)	2	.001
	12.50-11.0	(Aut.Cont/Aut.Treat)	2	.118
	12.00-11.0	(Norm.Cont/Aut.Treat)	2	.007
Audition (Posttest)				
	12.75-12.5	(Norm.Cont/Aut.Cont)	2	.002
	12.50-11.0	(Aut.Cont/Aut.Treat)	2	.63
	12.75-11.0	(Norm.Cont/Aut.Treat)	2	1.14
Vision (Pretest)				
	14.25- 8.5	(Norm.Cont/Aut.Cont)	2	3.97
	8.50- 7.5	(Aut.Cont/Aut.Treat)	2	.009
	14.25- 7.5	(Norm.Cont/Aut.Treat)	2	5.48
Vision (Posttest)				
	14.00- 8.0	(Norm.Cont/Aut.Cont)	2	2.94
	8.00-11.5	(Aut.Cont/Aut.Treat)	2	.75
	14.00-11.5	(Norm.Cont/Aut.Treat)	2	.51

*$p < .05$