The Effects of Exercise Intensity on the Stereotypic Behaviours of Individuals with Autism

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ABSTRACT

The effects of exercise intensity on the stereotypic behaviours of three autistic subjects were examined. Two exercise programs which differed on the basis of intensity as measured by heart rate were implemented. The moderate exercise program involved 15 minutes of walking, while the vigorous exercise program involved 15 minutes of jogging. The frequency of stereotypic behaviour were measured prior to exercise, immediately following exercise and 90 minutes following exercise.

The results indicated that significant reductions in stereotypic behaviours occurred as a function of the vigorous exercise condition only. The mean reduction of stereotypic behaviours between pre jogging and post jogging was 17.5%. The duration of these reductions was found to be temporary. Increases to pre-exercise levels were noted in stereotypic behaviours one and a half hours following implementation of the exercise conditions. The interrater reliability measure was 85%.

For the purpose of examining any differential effects of exercise intensity, the stereotypic behaviours of all subjects were categorized into three components motor, verbal and other. The motor component of stereotypic behaviour was most prominent. The moderate exercise condition had little effect on the motor component, while the vigorous exercise condition resulted in a mean reduction of 17%. The interrater reliability measure for the differentiation of stereotypic behaviours was 75%.

RESUME

Les conséquences de l'intensité des exercices physiques sur les comportements stéréotypés de trois sujets autistiques furent observées. Deux programmes d'exercices furent réalisés, chacun d'eux ayant une demande d'intensité différente celle-ci etant controllée à partir des battements cardiaques. Le programme d'exercices modérés consistait à de la marche pour une période de quinze (15) minutes, tandis que le programme d'exercices vigoureux consistait à courir pour une durée de quinze (15) minutes. La fréquence d'apparition des comportements stéréotypés fut mesurée à trois reprises: avant les exercices, tout de suite après les exercices, et quatre-vingt-dix (90) minutes plus tard.

Les résultats ont démontré qu'une baisse significative des comportements stéréotypés a lieu seulement lorsqu'on applique le programme d'exercices vigoureux. La diminution des comportements stéréotypés observés avant et après la course représentait une moyenne de 17.5%. Toute fois la durée de cette diminution s'avéra temporaire. Une heure et demie après avoir éxécuter les exercices on pouvait remarquer une augmentation des comportements stéréotypés par rapport aux mesures établis avant les exercices. La coefficient d'objectivité était de 85%.

Afin d'observer les différentes conséquences de l'intensité d'exercice, les comportements stéréotypés des sujets furent classée par catégories: comportements moteurs, verbaux ou autres. Les composantes motrices du comportement stéréotypé étaient les plus importantes. Le programme d'exercices modérés avait peu de conséquences sur les composantes motrices tandis que le programme d'exercices vigoureux amena une diminution moyenne de 17%. La coefficient d'objectivité pour la différences entre les comportements stéréotypés était de 75%

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CHAPTER I

INTRODUCTION

1.1 The Syndrome of Autism

The National Society for Autistic Children (1977) recognizes autism as a developmental disorder ranging in severity and occurring initially in the first three years of life. According to the National Society (1977) autism occurs approximately once every 2,000 births, throughout the world and is four times more common in boys than girls.

Ritvo and Freeman (1978) consider autism as a syndrome and point out that a syndrome functions as a "theoretical way station" in which clinically similar phenomena are apparent but lack a precise etiology. The syndrome of autism thus consists of a number of symptoms and the behaviourial expression of these symptoms characterize the person as autistic.

The National Society For Autistic Children in the United States developed a set of four defining characteristics of autism (Ritvo & Freeman, 1978). According to these criteria, autism can only be used to describe an individual who possesses all four symptoms plus the manifestation of these symptoms prior to 30 months of age.

1) Disturbances of developmental rates and sequences

2) Disturbances of responses to sensory stimuli

3) Disturbances of speech, language-cognition and nonverbal communication

4) Disturbances in the capacity to relate to people, events, and objects.

In addition to these essential features several associative features of autism are highlighted. These include: a) stereotypic motor patterns (e.g. body rocking, hand flapping, finger distortion); b) aggressiveness; c) passion for sameness; d) mood changes (unexplained crying or laughing); e) under or over reactiveness; and f) lack of knowledge of danger (Ritvo and Freeman, 1978).

The American Psychiatric Association (1987) in the DSM-III-R classified autism as a subgroup of the general category Pervasive Developmental Disorders and outlined four essential features

1) Qualitative impairment in reciprocal social interactions.

2) Qualitative impairment in verbal and nonverbal communication, and in imaginative activity.

3) Markedly restricted repertoire of activities and interests.

4) Onset during infancy or childhood.

Examples are given to further describe each essential feature. Impairment in reciprocal social interactions are characterized by the failure to develop interpersonal relationships and by lack of responsiveness to, or interest in, people. Impairment in communication and imaginative activities are manifested as immediate or delayed echolia, pronoun reversal, abnormal speech melody and abnormal nonverbal communication. The third essential feature, markedly restricted repertoire of activities and interests adopts several forms: reactions to minor changes in the environment, motor stereotypies (hand flapping, swaying body movements), verbal stereotypies (repetition of words), and unreasonable insistence on following routines. The present study examined specifically these motor and verbal stereotypies which are characteristic of individuals with autism and attempted to reduce the frequency of their expression as a direct function of exercise.

In terms of age of onset, the DSM-III-R (1987) states that in most cases onset occurs before the age of three. However because of the difficulty in establishing exactly age of onset, some flexibility is permitted. The DSM-III-R (1987) estimates the prevalence of the Autistic Disorder to be 4-5 children in every 10,000. The prevalence of Pervasive Developmental Disorders (including Autistic and Other Disorders not Otherwise Specified) is estimated at 10-15 children in every 10,000.

As well as the four essential features, the DSM-III-R (1987) includes the following six associated features:

1) Abnormalities in the development of cognitive skills.
2) Abnormalities in posture and motor behaviour.
3) Odd responses to sensory input.
4) Abnormalities in eating, drinking, or sleeping.
5) Abnormalities of mood.
6) Self-injurious behaviours.

These associative features vary among individuals in terms of presence and severity. The combination of the essential and associative features allows professionals to make a clear diagnosis of the Autistic Disorders, as opposed to a Pervasive Developmental Disorder Not Otherwise Specified (PDDNOS) (DSM-III-R, 1987).

In recent years autism has been viewed as a biologically determined behaviourial syndrome of varying etiology (Coleman & Gillberg, 1985). Gillberg (1990) stated that the syndrome of autism can be behaviourially defined as delay or deviance in three areas: 1) social relatedness; 2) communication; and 3) behaviour/imagination. Gillberg (1990) further argued that the age of onset (prior to 30 months of age) not be considered as a necessary criteria, as age is not a behaviourial criterion.

The frequency of occurrence of autism has always been believed to be in the range of 4-6 per 10,000 births (Ritvo and Freeman, 1978). More recent investigation (as cited in Gillberg, 1990) have found the syndrome of autism to be much more common. For example: a) Lorna Wing reported frequency figures of 21 per 10,000 in London; b) Gillberg confirmed this with frequency figures of 21 per 10,000 in Swedish teenagers; c) In 1986 Steffenburg and Gillberg found 6.6 per 10,000 autistic children in Sweden; d) in Canada, Bryson (1988) reported a figure of 10.1 per 10,000; and e) Tanoue (1988) found a frequency of 13.6 per 10,000 Japanese children.

Ritvo and Freeman (1978) stated that one of the characteristics of the syndrome of autism is disturbances of developmental rates and sequences. These disturbances may occur in the motor, social-adaptive or cognitive pathways and can be manifested as either delays, arrests, and/or regressions. Delays in motor development for example, include normal gross motor functioning with disruptions in fine motor skills; or normal motor development up to age two, then a noticeable slowing down.

Little has been written concerning the motor proficiency of autistic individuals. Reid and Morin (1985) stated that there is a need for empirical work describing motor functioning both quantitatively and qualitatively. This much needed longitudinal research on motor development would greatly contribute to defining of the syndrome of autism.

The research that has been done has been contradictory in nature. Kanner (1943) stated that autistic children were normal in their motor development. This statement was supported by several other researchers (e.g. Alderton, 1966; Rimland, 1964; Wing 1966). However, more recent research has found the opposite to be true (Ornitz, Guthrie, & Farley, 1977; Reid, Collier & Morin, 1983; Reid & Morin, 1981, 1985; Singleton, 1974; Wing, 1976).

Reid and Morin (1981) briefly discussed the motor performance of autistic children. They found a dearth of information pertaining to the proficiency of autistic individuals, but an agreement among researchers and clinicians that autistic individual do display "inappropriate" motor patterns (p. 26). One of the most researched inappropriate behaviours are those of the stereotypic nature.

1.2 Stereotypic Motor Patterns

A large majority of autistic individuals engage in acts of self-stimulation or stereotypic motor patterns. As such, self-stimulation is considered to be one of the most defining characteristics of autistic individuals (Margolies, 1977; Koegel, Egel, & Dunlap, 1980). These behaviours range from gross motor movement such as body rocking, arm flapping, pacing or jumping; to subtle fine motor movements such as spinning objects, or staring.

Research has supported the elimination or suppression of these stereotypic behaviours since they interfere with performance. Lovaas, Litrownik, and Mann (1971) noted that while children were involved in self-stimulatory behaviours they were unable to attend to relevant stimuli. Self-stimulatory behaviours also interfere with previously learned behaviours (Bucher & Lovaas, 1968), acquisition of new behaviours (Koegel & Covert, 1972), as well as appropriate play behaviours (Koegel, Firestone, Kramme, & Dunlap, 1974).

A variety of means to reduce stereotypic behaviours have been put forth. The simplest means offered is providing the individual with the opportunity to engage in diverse behaviours (Berkson & Mason, 1964). Additional techniques include reinforcing alternative responses, ie. sitting still (Mulhern & Baumeister, 1969). More direct methods include various forms of punishment, such as electric shock (Lichstein & Schreibman, 1976), inhalation of ammonia (Baumeister & Baumeister, 1978), and overcorrection (Foxx & Azrin, 1973; Maag, Rutherford, Wolchik & Parks, 1986). However, in most cases, while results have shown some decrease in self-stimulatory behaviours, the reductions have not been substantial and have not been generalizable outside of the classroom or therapy session (Koegel et al. 1980).

A more recent method that has been employed to reduce stereotypic behaviours has been physical activity. Several studies have probed the influence of exercise on self-stimulation (Allen, 1980; Bachman & Fuqua, 1983; Kern, Koegel, Dyer, Blew & Fenton, 1982; Kern, Koegel & Dunlap, 1984; McGimsey & Favell, 1988; Watters & Watters, 1980).

Watters and Watters (1980) examined the effects of physical exercise on the self-stimulatory behaviour of autistic children. To assess these influences the level of self-stimulation for each child was observed during language instruction which followed the administration of one of the three experimental conditions: jogging, watching television or regular academic work. The results of this study showed a mean decrease in self-stimulation of 32.7% following the exercise precondition. As no decrease was noted following the television precondition, the changes were attributed to the effects of the exercise, and not due to changes in normal activities. The authors raised several interesting questions to be examined in future research. These included: a) the effects of longer more intense exercise; b) how exercise would effect the learning of a new task; and c) the overlap between the self-stimulatory behaviour, the academic task, and the physical exercise.

Allen (1980) examined the effects of three conditions (no jogging, five minutes of jogging and 10 minutes of jogging) on the disruptive behaviours, and the duration of these effects. The 10 minute jogging condition was most effective in reducing the number of negative behaviour. Examining the effects of the jogging conditions on an hourly basis, Allen (1980) concluded that in the first hour following jogging, subjects engaged in less disruptive behaviours.

Kern and colleagues (1984) examined the differential effects of mild and vigorous exercise on stereotypic behaviours. Previous research has indicated that certain types and amounts of exercise may exert more influence than others on such behaviours (Allen, 1980). Kern et al. (1984) found that the mild exercise condition (ball playing) had little or no influence on the subject's subsequent stereotypic behaviours. In contrast the vigorous exercise condition (jogging) was always followed by reductions in stereotypic behaviours. These results corroborate previous research (Kern et al., 1982; Watters & Watters, 1980), and indicate that certain types of exercise have differential effects on stereotypic behaviours in autistic individuals. While the above study by Kern and colleagues (1984) does add to the literature by demonstrating the differential effects of exercise, there is an inherent weakness in the assumption made by the authors. Kern et al. (1984) assumed that the two activities, ball playing and

jogging differed on the basis of intensity. For individuals who are overweight or in poor physical condition any type of exercise is more strenuous, thus ball playing could be a vigorous activity (McArdle, Katch & Katch, 1986). The present study did not make this assumption, and by monitoring heart rates for both exercise conditions (moderate and vigorous), it was possible to differentiate based on intensity between the two exercise program.

Self-stimulatory behaviours, responding to a task and physical exercise all require certain motor responses. Watters and Watters (1980) hypothesized that it may be possible to further increase the effectiveness of physical exercise in the elimination of self-stimulatory behaviours by closely matching the exercise to the individuals behaviours. The present study has controlled for the similarities that exist between self-stimulatory behaviours and physical exercise and focused on the issue of intensity.

All of the above studies have increased our knowledge concerning the effects of physical exercise on stereotypic and disruptive behaviours. The benefits of exercise are multi-facetted. In addition to improvements in behaviour (Kern et al., 1982), improvements in learning have been noted in children with spina bifida (Krebs, Eickelberg, Krobath & Baruch, 1989) and muscular dystrophy (Eickelberg, Less & Engels, 1976), as well as improvement in moods (Dyer & Crouch, 1988). Another benefit is the ease in which such a program can be implemented. An exercise

program is less demanding than behaviour modification techniques, requires less preparation, and provides health benefits. The specific implications of these findings to the educational setting require further investigation concerning programming, such as when are the most beneficial times to schedule physical exercise, as well as the previously noted concerns of effects of learning a new task, duration, intensity, and types of exercise (Bachman & Fuqua, 1983; Kern et al., 1982; Kern et al., 1984; McGimsey & Favell, 1988; Watters & Watters, 1980). Important questions that exist concerning the effects of exercise, pertain to intensity and duration of effects. Future research must address these concerns if one hopes to provide practitioners with effective strategies to implement these positive findings in the educational setting.

Specifically, the question of intensities of exercise is important. Kern et al. (1984) concluded that vigorous exercise resulted in greater decreases of stereotypic behaviours than mild exercise. However, the process by which the authors differentiated between the two exercise conditions was not scientific. If researchers are to state preference for one mode of exercise, it is necessary to differentiate between moderate and vigorous levels of exercise and then examine their relative effects on stereotypic behaviour. As well, because autistic children exhibit a failure to maintain and generalize behaviours, an examination the duration of any reductions in stereotypic behaviours is necessary.

1.3 Statement of the Problem

The purpose of this study was to examine the influence of different intensities of exercise on the stereotypic behaviours of autistic individuals and the duration of these effects.

1.4 Hypotheses

1.4.1 It is hypothesized that significant decreases in stereotypic behaviours will occur with vigorous exercise only.

1.4.2 It is hypothesized that these decreases will be evident immediately following physical exercise, but the effects will dissipate with time.

1.5 Delimitations

1.5.1 Because certain stereotypic behaviours tend to decrease with age (Garfin, McCallon, & Cox, 1988; Mesibov, Schopler, Schaffer, & Michal, 1989), only preadolescent children were used in the study.

1.5.2 Because stereotypic behaviours are more frequent in lower functioning individuals, the subjects used in this study were low functioning.

1.5.3 Because of the undetermined etiology of stereotypic behaviours, generalizations of findings to other autistic children should be done with caution.

1.5.4 Because all subjects involved in this study were of the same age, generalizations to younger and/or older autistic individuals should be done with caution.

1.6 Limitations

This investigation has the following limitations:

1.6.1 The motivation level of autistic children is often low or absent (Egel, 1980; Koegel & Egel, 1979). Though considerable effort was made to ensure continuous and vigorous exercise, it cannot be assumed that efforts were maximal or equal across subjects. However, the monitoring of heart rates during both exercise conditions allowed differentiation on the basis of intensity.

1.6.2 The monitoring of heart rates was done by means of obtaining a radial pulse before and after each exercise session. Though radial monitoring is a viable means for determining heart rate (Shephard, Cox, Corey & Smyth, 1979), the use of a Sport Tester (Polar Vantage Quantum XL) would have been a preferred method of continuously monitoring the subject's heart rates. However due to the nature of the subjects, the use of a Sport Tester was negated as the subjects refused to wear the device.

1.7 Definition of Terms

1.7.1 Moderate Exercise Condition: Consisted of walking at an easy pace

1.7.2 Vigorous Exercise Condition: Consisted of jogging at a pace sufficient enough to elicit intense effort while not placing subjects in distress.

1.7.3 Shadow: A classroom assistant assigned to a specific student who attends to all needs of the student and is also involved in implementation of school programs.

CHAPTER II

REVIEW OF LITERATURE

2.1 Introduction

The purpose of this investigation was to compare the effects of moderate versus vigorous exercise on the stereotypic behaviours of autistic children. Literature which is relevant to this study will be examined in the following sections: (2.2) Definition and Diagnosis of Autism, (2.3) Etiology, (2.4) Learning Characteristics, (2.5) Stereotypic Behaviours, (2.6) Exercise and Stereotypic Behaviours, (2.7) Physical Activity and the Autistic Individual, (2.8) Teaching the Autistic Child, (2.9) Summary.

2.2 Definition and Diagnosis of Autism.

The first description of autism per se, was done in the 1940's by Dr. Leo Kanner. He noticed similar behaviourial patterns in children referred to a clinic. While there was a great amount of variability and degrees of disturbances, he did find the manifestation of specific features. These features included: inability to develop relationships with people, a delay in speech acquisition, non-communicative use of speech following its development, delayed echolia, reversal of pronouns, repetitive and stereotypic play activities, obsessive maintenance of sameness, a lack of imagination, good rote memory, and a normal physical appearance (Kanner, 1943).

When Kanner first started studying autism, many of the children were considered to be severely feeble-minded or to have a hearing impairment. Careful examination revealed very soon that the children's cognitive potentialities were only masked by the "affective" disorder. In fact, Kanner was so impressed by the unusual skills, musical abilities, rote memory feats, and number manipulation skills, that he believed they had normal or above average intelligence (Kanner, 1943). We now know this is not true as only 20% score above 70 on IQ tests. Indeed, 60% have IQ scores below 50 (Bartak, 1978).

While autism and mental retardation frequently coexist (DSM-III-R, 1987, Rutter, 1978), autism is considered a unique disorder since a) small numbers of autistic children have normal or superior intelligence, b) while both autistic and individuals with mental retardation have seizures, age of onset of the seizures differs between the two populations; early childhood in mental retardation, adolescence in autism (Rutter & Schopler, 1987), c) the ratio of male to female is 4:1 for autism, while only slightly more individuals who are mentally retarded are male, and d) individuals with mental retardation do not have the essential features associated with Pervasive Developmental Disorders, ie. they are sociable and can communicate (DSM-III-R, 1987).

The relationship between autism and schizophrenia is a controversial one as some researchers believe that infantile autism is the earliest form of schizophrenia (Bender, 1947), whereas others believe that the two are distinct conditions (Rutter & Schopler, 1987). The DSM-III-R (1987) addresses the relationship between autism and schizophrenia by discussing the key differences that exist between the two conditions. Autism is generally diagnosed in early childhood, while schizophrenia is rarely diagnosed so early. While the stereotypic behaviours associated with autism may be mistaken for delusions, delusions and hallucinations are rare in autism. Rutter and Schopler (1987) differentiated between autism and schizophrenia on the basis of a) age of onset, b) family history, c) scarcity of delusion in autism, d) near normal periods are associated with schizophrenia, not so with autism, and e) seizures occur in about 25% of diagnosed cases of autism, but are rare in schizophrenia. The DSM-III-R (1987) cautioned that once a diagnosis of autism has been made according to the four essential features, only with the presence of prominent delusions or hallucinations should an additional diagnosis of schizophrenia be made.

There have been numerous attempts to develop an objective classification system since Kanner's first description of the features associated with autism. However, because the syndrome of autism is heterogeneous in nature, problems of definition,

diagnosis, and differentiation exist (Volkmar et al., 1988). Rutter and Schopler (1987) indicated that the various rating scales used for diagnosis or differentiation of autism fall into three main groups: (1) parental or teacher questionnaires, e.g. the ABC (Volkmar et al., 1988); the MAS (Durand & Crimmins, 1988; (2) standardized interviews with parents, e.g. the ADI (Le Couteur et al., 1989) and (3) observationally-based checklists, e.g. the CARS (Schopler, Reichler, DeVellis, & Daly, 1980). Several considerations must be taken into account in the development of a diagnostic rating scale or checklist. These are: a) the range in abilities of autistic individuals; b) the "age factor" (Parks, 1983), ie. developmental changes; and c) the problem of appropriate comparison groups (Volkmar et al., 1988).

Problems exist with diagnostic instruments already in use. Some of these rating scales, for example the AAMD Adaptive Behaviour Scale-School Edition, (Lambert & Windmiller, 1981; and the Vineland Adapted Behavior Scales (Sparrow, Balla, & Cicchetti, 1984) were developed with severely handicapped children in mind, and are not appropriate for use with an autistic individual. These scales do not reflect the specific characteristics of autism, but rather the lack of a skill. This may be a reflection of an intellectual handicap, not necessarily autism.

Other problems are the unreliability of parental questionnaires such as the ADI (Le Couteur et al., 1989). They require the recollection of behaviours and events years prior, and may not accurately assess the quality of the behaviours (Rutter & Schopler, 1987; Volkmar et al., 1988).

Gillberg (1990) stated that autism can be best envisioned as a biologically determined behaviourial syndrome of varying etiology. He outlined three major areas of deviance as diagnostic criteria: social relatedness, communication, and behaviour\imagination. Gillberg (1990) questioned the notion of a separate diagnosis for infantile autism in view of the diversity that exists in terms of etiology, severity, and behaviourial expression within the syndrome. Gillberg (1990) argued that autism should be diagnosed and then additional features specified (severity, medical condition, cognitive level), similar to the diagnosis of cerebral palsy.

Since the early 1940's the definition and diagnosis of autism has undergone ample change from Kanner's list of 10 specific features (Kanner, 1943), to the DSM-III-R (1987) list of four essential features, to Gillberg (1990) list of three diagnostic criteria. Reducing the number of criteria has not cleared up confusion that surrounds the syndrome of autism, and research clarifying the diagnosis of autism and differentiating autism from other disorders such as Asperger syndrome remains a priority.

2.3 Etiology

There has been a proliferation of theories concerning the exact etiology of autism. To date the possible explanations put forth range from blaming the parents to chromosomal abnormalities. In order to provide an overview of the varying etiologies, four categories have been created to represent the diversity of approaches concerning the description of autism. The categories are: 1) emotional approach; 2) physiological approach; and 3) behaviourial approach; and 4) cognitive approach.

2.3.1 Emotional Approach

While the precise etiology of autism still remains undefined, theorists are moving away from earlier beliefs that autism was an emotional disturbance. Those who supported the emotional etiology of autism felt that a child was normal at birth and became autistic due to cold-hearted parents (Kanner, 1943) or parental rage and rejection (Beetleheim, 1950). This emotional theory has received little empirical support (DSM-III-R, 1987). Autism affects children from various ethnic and racial backgrounds whose parents vary in education, social class, and personality (Ritvo, 1976). The generalization that bad parenting may be a cause of autism is not consistent across such diversity. As well, recent epidemiological studies have further discounted the association between autism and social class (Gillberg, 1990).

2.3.2 Physiological Approach

The physiological approach encompasses a variety of research which has been done concerning the etiology of autism. Autism has been defined as a physical dysfunction within the central nervous system (Ritvo & Freeman, 1978); unspecified neurological disorder (Rutter & Schopler, 1987); a organic neurodevelopmental disorder (Le Couteur, 1990); and a biologically determined behaviourial syndrome (Gillberg, 1990). While the terminology may vary from researcher to researcher, the underlying notion is that autism is biologically determined. The evidence supporting the physiological approach is numerous. The development of epileptic seizures in approximately 25% of individuals with autism (DSM-III-R, 1987) lends supports a neurological dysfunction theory. Researchers have shown an association between autism and several medical conditions such as the fragile X syndrome (Hagerman, as cited in Gillberg, 1990), congenital rubella (Chess, Korn & Fernandez, 1971), and tuberous sclerosis (Gillberg, Steffenburg & Jakobsson, 1987). Gillberg (1990) has provided an excellent overview of biological factors which have been associated with autism.

In his 1985 article, Ornitz examined the neurophysiology of infantile autism and discussed how two possible neurophysiological hypotheses describe certain aspects of autistic behaviour. The first hypothesis discussed by Ornitz is termed the "Telencephalic Hypothesis". This hypothesis contends that certain disorders of

hemispheric lateralization affect language, and disorders in language are profound in autism (Ornitz, 1985). The second hypothesis discussed is the "Brainstem-Diencephalic Hypothesis". This hypothesis accounts for difficulties expressed by young autistic individuals in controlling their responses to sensory stimuli and their motor output (Ornitz, 1985). Ornitz summarized the article by stating that neurophysiological evidence exist to support both hypotheses, as both parallel autistic behaviours such as language deficits or sensory modulation (Ornitz, 1985).

2.3.3 Behaviourial approach

The behaviourial approach differs from the physiological approach in that it is not concerned as much with the underlying cause of autism, but rather the diagnosis of an individual based on the presence or absence of specific behaviours (Lovaas, Schreibman & Koegel, 1974). Pioneer work within the behaviourial approach was done by Ferster in 1961. The nature of Ferster's work was that the autistic individual's failure to develop socially appropriate behaviours was due to the inability to find reinforcement from the environment (Lovaas et al., 1974). The focus of these early studies was not the amount of learning which occurred, but rather how the learner's environment was altered to make it reinforcing and thus stimulate learning (Lovaas et al., 1974).

Recently Lovaas and Smith (1989) have attempted to expand on the earlier work done by Ferster. The authors discussed the methodological resolutions adopted by behaviourists in order to improve the understanding of autistic children. These resolutions include: 1) a separation of behaviours; 2) a concentration on the immediate environment; and 3) an emphasis on inductive research. The separation of behaviours allows for the study of behaviours in other groups of children who may not be autistic but who exhibit similar behaviours, thus broadening the research data base. The focus on the immediate environment permits effective interventions to be identified, rather than having the researcher focus on past history.

Lovaas and Smith (1989) have proposed a behaviourial theory of autistic children. This theory is based on four tenets:

> 1) The laws of learning adequately account for autistic children's behaviour.
>
> 2) The behaviourial deficits found in autistic children are not central deficits, but rather developmental delays.
>
> 3) When autistic children are placed in a special environment, they exhibit the capacity to learn.
>
> 4) The failure in normal environments, and the success in special environments can be viewed as a mismatch between the autistic child's nervous system and the normal environment, and not a result of a diseased nervous system.

The tenets above provide the basis by which behaviour changes are effected through manipulation of behaviourial consequences (Lovaas & Smith, 1989). Some practical questions remain regarding

implementation of behaviourial procedures, but the behaviourial theory provides an alternative way to deal with autistic children.

2.3.4 Cognitive Approach

Recently, another hypothesis has been put forth to explain the nature and cause of autism. It is based on the belief that cognitive deficits may underlie the social impairment associated with autism (Baron-Cohen, 1989). One such deficit which has been found in autistic individuals is their inability to attribute beliefs to others (Baron-Cohen, Leslie, & Frith, 1985). This hypothesis has also been termed "The Theory of Mind" after the work of Premack and Woodruff. The theory of mind requires an individual speculating the presence of mental states and manipulating these in order to explain and predict another person's behaviour (Baron-Cohen, 1989; Boucher, 1989).

Baron-Cohen et al. (1985) tested the ability of autistic children, non-autistic mentally handicapped children, and non-handicapped controls to attribute a belief to another person (a first-order belief attribution). They found that 80% of autistic children were unable to do so. Baron-Cohen (1989) examined the 20% of autistic children who were able to achieve first-order belief attribution to determine if they were able to attain higher levels of the theory of mind. Using the same three test groups, Baron-Cohen (1989) found that the autistic group were unable to achieve

second-order belief attributions. Based on these experiments, it is the belief of Baron-Cohen and colleagues that to some degree, all autistic individuals are impaired in their ability to use the theory of mind.

Boucher (1989) reviewed the theory of the mind hypothesis of autism and discussed the theory in terms of its psychological and philosophical aspects, as well as the theory broad and narrow use in developmental psychology. An assessment of the hypothesis and three general postulates to summarize the Baron-Cohen et al. (1985) hypothesis are provided. Boucher (1989) discussed some of the criticism regarding the theory but concluded that the theory of mind hypothesis of autism has provided a new way of conceptualising autistic behaviour.

Thus, while the exact etiology of autism remains unknown, research supporting the emotional theory of autism has not been forthcoming. The belief that autism results from an unspecified neurological disorder (Rutter & Schopler, 1987) is the general belief among researchers (Gillberg, 1990; Le Couteur, 1990). The behaviourial approach and cognitive approach provide alternative methods of viewing the syndrome of autism. Their focus is not as concerned with the exact etiology but rather the behaviours exhibited (Lovaas & Smith, 1989) or the specific behaviour impairments (Baron-Cohen et al., 1985).

2.4 Major Learning Characteristics

A number of behaviourial characteristics are important with regard to how autistic children learn. These include: imitation; motivation; generalization and maintenance; and stimulus overselectivity.

2.4.1 Imitation

Numerous studies have examined the inability of autistic individuals to imitate motor actions (DeMyer et al., 1972; Jones & Prior, 1985; Prior, 1979; Wing, 1976). The ability to imitate involves the synthesis of interest, attention, motivation, as well as a physical component (DeMyer, 1976). Reasons concerning the inability of autistic learners to imitate centre on the above mentioned components and include visual-motor disabilities (DeMyer 1976), motivational deficiencies (Prior, 1979), and stimulus overselectivity (Varni, Lovaas, Koegel, & Everett, 1979). A recent study suggested a possible link between poor motor imitation skills and neurological dysfunction (Jones & Prior, 1985)

DeMyer et al. (1972) noted that autistic learners performed significantly poorer than a group of mentally subnormal boys on tasks involving imitation. The autistic learners were most deficient on body imitation tasks. Wing (1976) has also indicated that autistic individuals are deficient on motor imitation tasks.

Jones and Prior (1985) examined the motor imitation abilities and possible neurological dysfunction in autistic children. They administered several tests to ascertain body movement. Tasks included dynamic body movement involving arm rotations and extension, as well as swinging motions. The authors stated that the tasks were designed to differentiate in terms of movement patterns and orientation of pathways (Jones & Prior, 1985, p. 40). Their results support previous conclusions that autistic children are deficient in the area of motor imitation.

2.4.2. Motivation

Lack of motivation has been cited in previous research (Egel, 1980; Koegel & Egel, 1979). This characteristic is evident by the apparent unresponsiveness of autistic children to environmental stimuli (Egel, 1980), their failure to explore new environments, or to seek out readily available food and comfort (Koegel et al., 1980).

Because lack of motivation is a limitation to all studies involving autistic learners, researchers have attempted a variety of methods and reinforcers in the hopes of influencing motivation. Practitioners have relied upon primary reinforcers such as food because of the difficulties in establishing natural reinforcers, such as praise, (Koegel et al., 1980) There are however problems with edible rewards. These include: a) the artificiality of

utilization in only restricted, not natural environments; b) the lack of generalization due to this restrictive use; and c) satiation on the part of the learner. (Koegel et al., 1980).

Consequently, alternative methods of reinforcing autistic learners have been employed. Rincover, Newsom, Lovaas, and Koegel (1977) examined the use of different sensory events (i.e. music) as possible reinforcers. They found that performance improved when correct responding was contingent upon reinforcement using the child's preferred mode of sensory stimulation. Reid and Morin (1981) supported this observation in a physical education setting. They suggested that the use of the most meaningful reinforcer available, as opposed to the traditional reinforcer of "free play" would be more appropriate with autistic children with whom free play is not a meaningful reinforcer.

Hung (1978) examined the use of self-stimulatory behaviours as reinforcement of spontaneous appropriate sentences. By means of a token system, the subjects earned 1 token for a spontaneous appropriate sentence and had to pay 2 tokens for 2 minutes of self-stimulatory behaviour. By making access to self-stimulation contingent on the occurrence of verbal responses, Hung (1978) demonstrated that repetitive stereotypic behaviours could be used as reinforcers to elicit appropriate behaviours in autistic children.

Wolery, Kirk and Gast (1985) assessed the effects and side effects of using stereotypic behaviour as reinforcement for correct responding on two autistic subjects. There were four conditions in this experiment: a) praise only, b) praise and stereotypic behaviour as reinforcement, c) extinction, and d) stereotypic behaviours only as reinforcement. The effects of using stereotypic behaviours as a reinforcer on correct responding were found to be positive. Decreases in incorrect responding from 21.3 (condition A) to 1.2 (condition B) were found for subject one and increases in mean correct responding from 58.5% (condition A) to 79.2% (condition B) noted for subject two .

The side effects of using stereotypic behaviours as a reinforcer were assessed by measuring the rates of target, other stereotypic behaviours, and appropriate behaviour in a free setting. Subject one showed a slight but transitory decrease in target stereotypic behaviour in free play when that behaviour had been previously used as a reinforcer. No consistent changes were noted in the rates of other stereotypic behaviours and appropriate behaviour. Subject two exhibited no relevant changes in the rates of either three of the above mentioned side effects.

In conclusion, the findings of Wolery and colleagues (1985) support previous research which used stereotypic behaviours as reinforcers (Hung, 1978). Their results revealed increased correct responding as a positive effect, and the monitoring of the side

effects showed no negative trends of increased rates of stereotypic behaviours.

Another issue of concern is when to reinforce. Autistic learners have a propensity to be caught up in the vicious circle of failure to respond correctly, low percentage of reinforcement, followed by repeated failure. Koegel and Egel (1979) developed a system of verbal and manual prompts which enabled individuals to remain on task until completion, thereby receiving a reward. It is important for educators as well as researchers involved with autistic children, to realize that lack of motivation is a problem, and to develop reinforcers which are meaningful to the individual.

In summary lack of motivation is a problem with autistic children. When attempting to teach new skills or elicit behaviours from autistic individuals, one must employ reinforcers which are meaningful in order to maximize the individual's responses.

2.4.3 Generalization and Maintenance

Generalization refers to the "occurrence of relevant behaviour under different non-training conditions" (Stokes & Baer, 1977, p. 350). Non-training conditions are different settings or with different people. Research has demonstrated that gains obtained in a classroom setting are usually not maintained nor generalized to other settings. Lovaas, Koegel, Simmons and Long (1973) found that the gains made by autistic children disappeared when the students

were institutionalized. The behaviours the subjects acquired in one setting did not carry over to another setting. There are several reasons why autistic children have problems generalizing and maintaining learned behaviours. One reason is that stimuli present in the classroom setting may not be present in other settings. Because of the tendency of autistic learners to cue into one or two particular stimuli (Rincover & Koegel, 1975), the absence of the stimuli in an extratherapy setting would result in failure of the subjects to generalize (Lovaas Koegel, & Schreibman, 1979). Another reason for the failure of autistic individuals to maintain a behaviour is lack of reinforcement or rewards in the other setting (Koegel & Rincover, 1977).

Several approaches exist which can increase the likelihood of generalization. Koegel and Rincover (1977) suggested altering the reward schedule in the classroom and including rewards in other environments. They found that by thinning the schedule of reward, greater durability of learned behaviours in extratherapy settings was achieved. Stokes, Baer and Jackson (1974) found that using different instructors resulted in greater generalization and maintenance of a hand greeting response in four children who were mentally handicapped. Training of behaviours in a variety of settings also promotes generalization (Stokes et al., 1974). As well training parents to use behaviourial techniques has proven to be a successful approach (Lovaas et al., 1973).

In a recent review article Edelstein (1989) discussed the issue of generalization. He reviewed the history and the definition of generalization, as well as the distinctions made between generalization, external validity, and transfer. Edelstein (1989) concluded that behaviour therapists have ignored the importance of generalization and that much more research is needed to predict and control the generalization of behaviours outside the clinical setting.

2.4.4 Stimulus Overselectivity

Stimulus overselectivity refers to the tendency to respond to a limited part of the environment (Gersten, 1983; Koegel et al., 1980). Autistic learners exhibit this characteristic. This does not imply that the autistic learner scans the environment and selects only relevant cues (Koegel et al., 1980). On the contrary, autistic children tend to select partially relevant cues, or cues which are irrelevant to the task at hand (Gersten, 1980; Lovaas et al., 1979). An example is the discrimination between a man and a woman based on shoe colour (Schreibman & Lovaas, 1973).

Stimulus overselectivity has far reaching implications in learning. Learning situations necessitate responding to multiple cues, presented in several modalities. If autistic learners are blocking out relevant cues, learning is obviously retarded (Lovaas et al., 1979).

Because of the difficulty autistic learners have in responding to relevant environmental cues, the stimulus overselectivity phenomenon suggests that the use of extra prompts (verbal, visual, or physical) used to guide learning makes learning more difficult for autistic children (Schreibman, 1975). The negative influence of prompts has been demonstrated on their learning (Koegel & Rincover, 1976). Schreibman (1975) developed a system of prompting that did not involve the addition of extra prompts into the environment, but rather exaggerations of cues already present. This is know as the "within-stimulus prompt".

Collier and Reid (1987) examined the educational implications of stimulus overselectivity with regard to teaching a motor task. They compared the effectiveness of two teaching models, one an "extra-stimulus prompt" model and the other a "within-stimulus prompt" model. Based on the stimulus overselectivity phenomenon, Collier and Reid (1987) hypothesized that a higher level of performance on a bowling task would be achieved by subjects receiving the "within-stimulus prompt" teaching model. Contrary to expectations, subjects receiving the "extra-stimulus prompt" model of instruction performed significantly better. The authors suggested the following as possible explanations: a) presence of the subject's preferred modality of prompting; b) haptic cues such as touch; c) proximity of extra-stimulus prompts to the training stimulus; d) physical manipulation of the subject's through the

task; and e) increased exposure to instructions. Collier and Reid (1987) concluded that the use of prompts was not detrimental to learning a motor task by autistic children,

2.5 Stereotypic Behaviours

One of the most defining characteristics of autistic individuals is the presence of self-stimulatory behaviours (Margolies, 1977). These behaviours are defined as repetitive non-functional behaviours (Foxx & Azrin, 1973) and include: rhythmic rocking, repetitive jumping, arm flapping, floor pacing, object spinning, hand staring, eye rolling or crossing and toe walking (Cushings, Adams & Rincover, 1983).

Berkson (1983) has discussed the history of stereotypic behaviours. Stereotypic behaviours have been observed in animals placed in captivity (ie. cage pacing) and in individuals suffering from depression or under stress (Lovaas, Newsom & Hickman, 1987). As well, monkeys reared in isolation tend to body rock.

Another group of researchers have examined the presence of stereotypic movements in infants. Thelen (1981) pointed out that these movements are transitional points in motor development and that the stereotypic movements eventually evolve into complex motor behaviours. A final category is the self-stimulatory behaviours observed in autistic, blind and individuals who are mentally retarded. These stereotypic movements differ from those present in

infants as these behaviours are immature, have been part of the individuals repertoire for a long time, and are unresponsive to environmental change (Berkson, 1983).

Berkson (1983) raised several interesting issues concerning how stereotypic behaviours are affected by the environment, why stereotypic behaviours are present, and their function. The moment-to-moment changes noted in stereotypic behaviours are affected by the general arousal of the individual and the presence of alternative activities. This has been the premise of behaviour modification techniques, reinforcing alternative activities. Berkson (1983) noted that while these techniques have altered the expression of stereotypic behaviours, they have not eliminated them from the behaviour repertoire of the individual.

Why are stereotypic behaviours present in the first place? Research has shown that these behaviours interfere with normal interactions (Koegel & Covert, 1972; Koegel et al., 1974; Lovaas et al., 1971, 1987). One view is that stereotypic behaviours serve some function by aiding motor and cognitive development (Thelen, 1981). If they fail to do so, Berkson (1983) hypothesized that they remain in the behaviour repertoire of an individual in order to provide some kind of stimulation that normally would have been provided through interaction with the environment.

Two models have been proposed to explain what controls stereotypic behaviours. The first proposed that stereotypic behaviours are controlled by an internal oscillator. Oscillators have been shown to be involved in the control of certain motor behaviours (Delcomyn, 1980). This is in opposition to the view that these behaviours are maintained by their sensory feedback, as internal oscillators do not necessitate external stimuli to maintain their pattern.

The second model proposed that stereotypic behaviours are maintained by self-stimulation. In this instance, the behaviours are depended on the feedback provided, thus altering or preventing feedback would modify the stereotypic behaviour. Berkson (1983) noted that research has shown that when a behaviour is dependent on manipulation of a source of stimulation, removal of the stimulation prevents the behaviour. An example noted by Berkson (1983) involved covering a table to silence the noise made by spinning an object on it. Once no auditory feedback was present, the stereotypic behaviour of spinning an object was stopped.

Two questions that the self-stimulation model raised were, who must control the input of the stimulation and why are stereotyped behaviours rhythmical? Berkson (1983) suggested that appropriate experimental conditions would be able to determine the answer to the first question and that these behaviours are rhythmical because moving in a rhythmical manner is most economical.

Berkson's (1983) main idea was that stereotypic behaviours are controlled by sensory input and that in order to maintain the input the behaviours must be repetitive, and that the most efficient manner to continue a behaviour is to move in a rhythmical pattern. An interesting point raised by Berkson (1983) concerned reducing stereotypic behaviours. The author suggested that if one attempts to reduce a stereotypic behaviour, the alternate behaviour presented must provide similar sensory feedback in order to be successful.

Berkson and Gallagher (1986) examined the relationship between normal and abnormal repetitive stereotyped behaviours. The authors stressed several differences that exist between the two behaviours: a) The duration of abnormal behaviours, i.e. an individual engages in these behaviours longer; b) these behaviours are more elaborate; c) they remain in the individuals behaviour repertoire for longer periods of time; and d) abnormal behaviours decrease with developmental age but increase with chronological age.

It is believed that abnormal stereotyped behaviours originate from disruptions in the normal interactions between a child and his\her environment (Berkson & Gallagher, 1986). Thus when an abnormal stereotyped behaviour is noted, one can look for a problem of interaction between child and environment. By identifying this "problem" and correcting the environment, subsequent decreases in the abnormal stereotyped behaviour should result. Berkson and

Gallagher (1986) discussed this experimental intervention and illustrated through several examples how these abnormalities could be minimized and normal child-environment interactions promoted.

Another self-stimulation theory which has been proposed is the perceptual reinforcement hypothesis of Lovaas and colleagues (1987). Their belief is that "self-stimulatory behaviours are operant behaviours that are maintained automatically by the reinforcing perceptual stimuli that they produce" (p.47). These stimuli can be visual, vestibular, tactile or auditory. As proof of this hypothesis Lovaas et al. (1987) argued along several points: a) The complex nature of some stereotypic behaviours supports the notion that learning variables must have been present, b) the most reliable and certain consequences of engaging in self-stimulatory behaviours are the perceptual stimuli produced by these behaviours, and c) these behaviours are reinforcing due to the perceptual consequences they generate.

Lovaas et al. (1987) discussed the distinct characteristics of perceptual reinforcers. There are several points that distinguish them from other reinforcers. These included: perceptual reinforcers are controlled by the individual, not by the social environment; and they are primary reinforcers and very durable.

Educational implications of this hypothesis are that self-stimulatory behaviours are learned behaviours and therefore greater control over them can be exercised by teachers and clinicians.

Studies have shown that by directly interfering with the perceptual reinforcement underlying the self-stimulatory behaviour (Berkson, (1983) or indirectly interfering by providing alternative behaviours (Rincover, Cook, Peoples & Packard, 1979), the stereotypic behaviour can be modified.

Abnormal stereotyped behaviours are complex behaviours that are maintained by sensory or perceptual reinforcers. These reinforcers are powerful and durable. Both Berkson (1983) and Lovaas et al., (1987) proposed that to reduce these behaviours, either the stimulation elicited by the behaviours must be removed from the environment, or the alternative behaviour presented must provide the individual with the same sensory stimulation. A variety of methods have been attempted to reduce stereotypic behaviours and these will now be discussed.

2.5.1 Managing Stereotypic Behaviours

When engaged in stereotypic behaviours autistic individuals do not respond to their environment. Lovaas et al. (1971) noted the inability of autistic individuals to attend to relevant stimuli when engage in self-stimulatory behaviours. Koegel et al. (1974) examined the effects of stereotypic behaviours on appropriate play behaviours and found that when self-stimulatory behaviours were suppressed the appropriate play behaviours of autistic children increased. Lovaas et al. (1987) found that autistic children were

hard to reach and oblivious to external stimuli when they were engaged in stereotypic behaviours. Because research has shown how stereotypic behaviours interfere with learning, the elimination or control of these behaviours remains a priority.

There have been many different attempts to control the self-stimulatory behaviours of autistic children. Mulhern and Baumeister (1969) reinforced sitting still, a behaviour incompatible body rocking to decrease self-stimulation.

Another method used to reduce self-stimulatory behaviours is physical punishment. Lichstein and Schreibman (1976) advocated the use of electric shock in their review article. They discussed previous use of electric shock to eliminate self-destructive and self-stimulatory behaviours (Baroff & Tate, 1968; Lovaas, Schaeffer & Simmons, 1965). The authors reviewed 12 articles which dealt specifically with the use of electric shock on autistic children and found the following positive effects: a) occurrence of response generalization (Lovaas et al., 1965); b) increased social behaviour (Bucher & Lovaas, 1968; Lovaas et al., 1965); and c) positive emotional behaviours (Lovaas et al., 1965). The negative effects that occurred were: a) fear of shock apparatus (Baroff & Tate, 1968); b) negative emotional behaviours (Bucher & Lovaas, 1968); and c) increase in other behaviours (Bucher & Lovaas, 1968).

Baumeister and Baumeister (1978) examined the effects of inhaling ammonia on the self-injurious behaviours of two children who were severely retarded. Their results revealed that within 3 days, the targeted behaviours were eliminated and even six months later, no self-injurious behaviours were noted. As well, the suppression of the behaviours occurred throughout the child's environment. Baumeister and Baumeister (1978) warned of the possible side effects of this treatment and state that careful consideration as well as medical consultation be done before implementing such a procedure.

A milder form of punishment which has resulted in substantial reductions of self-stimulatory behaviours is overcorrection (Foxx & Azrin, 1973). There are two components of overcorrection. The first is restitution, which requires returning the environment to an improved state (Maag et al., 1986). For example if a subject overturned a table, he would be required to restore the table to its correct position and dust it (Foxx & Azrin, 1973). The second component is positive practice. This requires repeatedly practising appropriate forms of the relevant behaviour (Maag et al., 1986). In the above example, a subject would be required to straighten up and dust other tables and furniture in the room (Foxx & Azrin, 1973).

In their 1973 study, Foxx and Azrin compared overcorrection to other methods, such as slapping and reinforcement to determine which method would results in the elimination of self-stimulatory behaviours. They found overcorrection to be an effective method of eliminating a variety of self-stimulatory behaviours (object-mouthing, hand-mouthing, head-weaving and hand-clapping). The reductions were immediate and at a near zero level within 10 days. As well, the elimination of the self-stimulatory behaviours was maintained by combining the overcorrection procedure with a verbal reprimand (Foxx & Azrin, 1973).

One criticism of the overcorrection procedure is the amount of time needed to implement the procedure. The usual time needed to implement overcorrection ranges from 5 to 20 minutes and thus detracts from learning time (Maag et al., 1986). To determine if shorter durations of overcorrection would be effective, Maag and colleagues (1986) compared two short (20 second and 60 second) overcorrection procedures. Their results indicated that with one subject, suppression of self-stimulation was achieved with the 20 second overcorrection procedure, while for the other subject, the 60 second procedure was more effective (Maag et al., 1986).

Another group of researchers has examined the effects of environmental factors on the self-stimulatory behaviours of autistic children. Frankel, Freeman, Ritvo and Pardo (1978) studied the effects of high and low environmental stimulation on

the stereotypic behaviours of high and low functioning autistic children. Their results indicated that stimuli present in the immediate environment may influence the self-stimulatory behaviours of autistic persons. Frankel et al. (1978) noted that in the high functioning autistic children the introduction of stimuli reduced their stereotypic behaviours while the opposite was true for the low functioning group. The authors concluded that stimuli present in the immediate environment may have differential effects on stereotypic behaviour depending on the child's level of functioning (Frankel et al., 1978).

The effects of unfamiliar conditions on the stereotypic behaviours of autistic children has also been examined. Runco, Charlop and Schreibman (1986) examined the influence of familiarity versus unfamiliarity on the stereotypic behaviours of six autistic boys by altering the therapist, the setting and the task presented. The results indicated that when an unfamiliar therapist was present, self-stimulation occurred more often compared to a familiar therapist. No significant differences were noted for the other two conditions. A possible explanation why more self-stimulation occurred with the unfamiliar therapist was that the familiar therapist had previously established control over the subjects' self-stimulatory behaviours (Runco et al., 1986). The subjects appeared to have discriminated between therapists, based on which one was liable to reprimand self-stimulatory behaviours.

Another important finding of this study was the inverse relationship between self-stimulation and correct responding. Previous research has shown that self-stimulation and correct responding function as competing reinforcers (Dunlap, Dyer, & Koegel, 1983; Koegel & Covert, 1972). Runco and colleagues (1986) found that self-stimulation may have interfered more with correct responding on familiar as opposed to unfamiliar tasks.

To promote decreases in self-stimulatory behaviours the authors suggested several treatment strategies. These included similarity between therapy and nontherapy situations and the use of multiple therapists.

Duker and Rasing (1989) examined the effects of redesigning the physical environment on the self-stimulation and on-task behaviours of three developmentally disabled subjects. The authors hypothesized that lowering the stimulation input of the three subjects would decrease the subject's self-stimulatory behaviours. They found that by modifying the physical environment to a less arousing one, the subjects' level of self-stimulation decreased and their level of on-task behaviour increased (Duker & Rasing, 1989). Their study supports the premise that autistic subjects are overaroused by their environment (Zentall & Zentall, 1983), and that by lowering the stimulation input present, which was achieved by simply redesigning the physical surroundings, it is possible to elicit positive behaviourial changes.

Dunlap and colleagues (1983) examined the effects of varying the intertrial interval duration on the level of self-stimulation and correct responding of four autistic children. The intertrial interval was defined as the amount of time between the termination of one trial by praise, and the beginning of another trial by an instruction (Dunlap et al., 1983). The duration of the intertrial intervals were less than four seconds (average 1-2 seconds) for the short condition and more than five seconds for the long condition. The results indicated that in the short intertrial interval condition self-stimulatory behaviours decreased and higher levels of correct responding were noted. The opposite was found to be true for the long intertrial interval condition (Dunlap et al., 1983). Thus by manipulating task variable, in this case timing, increases in task performances were elicited and concurrently, decreases in self-stimulatory behaviour resulted.

Haring, Breen, Pitts-Conway and Gaylord-Ross (1986) examined the effects of differential reinforcement of other behaviours (DRO) on the stereotypic behaviours and task performance of three autistic students during dyadic instruction. By means of a token system, the subjects were reinforced by the peer student for not engaging in stereotypic behaviours during the peer's instruction session and by the teacher for correct responding during their instructional session. When 10 tokens were obtained (five for correct responding and five for not engaging in stereotypic

behaviours) free time was rewarded. The results indicated that with the DRO procedure, there was a rapid reduction in the number of trials of peer instruction needed to reach five trial absent of stereotypic behaviours. The most dramatic result was a decrease from 158 trials to a mean of 29.8 trials for one subject (Haring et al., 1986).

During the DRO conditions two of the three subjects had higher levels of correct responding, while the third subject was found to have achieved a ceiling level. In this study, the task variables were manipulated by requiring abstention from disruptive behaviours and correct responding. Thus similar to previous research on the manipulation of task variables (Dunlap et al., 1983), the subjects were motivated to perform and reductions in stereotypic behaviours occurred concurrently

Koegel and Koegel (1990) examined the efficiency of a self-management package on reducing the stereotypic behaviours of four autistic students. The first experiment found that when the self-management package was introduced, rapid decreases in stereotypic behaviours occurred. The withdrawal of the package resulted in increased stereotypic behaviour (Koegel & Koegel, 1990). The second experiment examined the maintenance of the self-management package as well as its generalization to different settings. The results indicated that in the absence of the treatment provider, reductions in stereotypic behaviours occurred through the

maintenance of the self-management package. While initial high levels of stereotypic behaviours were noted in another setting, once the self-management package was introduced reductions in stereotypic behaviours occurred rapidly (Koegel & Koegel, 1990).

In summary, a variety of methods have been used to reduce stereotypic behaviours. These range from implementing severe forms of physical punishment such as electrical shock (Baroff & Tate, 1968; Lovaas et al., 1965) and inhalation of ammonia (Baumeister & Baumeister, 1978) to milder forms such as overcorrection (Foxx & Azrin, 1973; Maag et al., 1986). Several researchers have attempted to reduce stereotypic behaviours by altering the physical environment of the autistic subjects (Duker & Rasing, 1989; Frankel et al., 1978; Runco et al., 1986), while others have varied task variables such as timing (Dunlap et al., 1983) and reinforcement (Haring et al., 1986). One method which has been shown to be successful in reducing stereotypic behaviours, as well as providing physical fitness benefits will now be discussed.

2.6 Exercise and Stereotypic Behaviours

A recent method used to reduce the frequency of stereotypic or self-stimulatory behaviours in individuals with autism has been the use of exercise. Several studies have examined the various effects of exercise on reducing these behaviours.

Watters and Watters (1980) examined three different conditions and their effects on the behaviour of five autistic boys. The three conditions were: jogging, watching TV, and regular academic work. The jogging consisted of eight to ten minutes in a school yard. The television condition was included to control for the possibility that changes in self-stimulation might be due to changes in regular routines, rather than the effects of jogging per se.

This study found that self-stimulatory behaviours decreased an average of 32.7% following the jogging condition. However, the level of correct responding in an answering task was not affected. Watters and Watters (1980) discussed the advantages of implementing a physical education program in that, unlike other methods used for decreasing self-stimulation (ie. punishment, time-out), jogging does not interfere with the classroom schedule as it can occur prior to teaching sessions. Also the program is less demanding on the teacher than behaviour modification techniques, requires little preparation, and has potential health benefits as well.

Allen (1980) examined the effects of 10 minutes of jogging on the disruptive behaviours of twelve boys who exhibited behaviourial and/or perceptual disorders. The jogging program was instituted for its physical benefits and as well as a means to reduce stress and modify disruptive behaviours. The teachers of the students involved in the jogging program noted that on days when the

students jogged, there were less disruptions in class and the students were better able to attend to their class work (Allen, 1980).

Comparing the negative behaviours that resulted from no jogging, five minutes of jogging, and 10 minutes of jogging, the author concluded that 10 minutes of jogging reduced the negative behaviours in half, supporting the premise that jogging is an effective means of reducing classroom disruptions.

Another interesting point is the duration of the effects of jogging. Allen (1980) analyzed the effectiveness of the program by examining the number of negative behaviours, on an hourly basis following the jogging condition. In the hour immediately following jogging, the subjects engaged in less disruptive behaviours and were able to remain on task. As a result, the classroom schedule was altered so that classroom topics which required attention and quiet behaviour were scheduled immediately following the jogging in order to obtain the maximum benefits from the program.

Borreson (1980) examined the effects of forced running on the self-injurious avoidance behaviours (SIB) of a male with profound mental retardation. The scope of this study spanned two years and two settings (school and residential institute). Several other methods had been previously employed to decrease the SIB of the subject. These included: differential reinforcement of other behaviours; reinforcement of incompatible behaviours, extinction

and a mechanical restraint program. Because of the ineffectiveness of all of the other above mentioned interventions a forced running punishment treatment was attempted.

The treatment consisted of forced running with physical guidance up and down a four-step training stairway every time the subject engaged in self-injurious behaviours. The subject's initial SIB frequency was 1,236 per day. This decreased dramatically to a frequency of zero only six days into the treatment phase. The average SIB for the treatment phase was two per day. Following removal of the forced running condition, the subject's SIB frequency rapidly increased to an average of 842 per day. With the return of the forced running condition, the subject quickly ceased to engage in self-injurious behaviours.

Generalization of the treatment occur across trainers and settings although not spontaneously. Increases in the first treatment phase were due to the substitution of another trainer. Several follow-ups probes were conducted, three months, six months, and two years following final treatment. It was noted that in this time, the subject had only manifested a total of five self-injurious behaviours, and had been able to acquire several skills previously unattainable.

Bachman and Fuqua (1983) studied the effects of antecedent exercise on the management of inappropriate behaviours of four males with trainable mental impairments. There were five phases in

their study where intensity and distance were manipulated. Phase one consisted of alternating between warm-up exercises and moderate jogging, short distance. Phase two alternated no jogging with vigorous jogging, moderate distance. Phase three was vigorous jogging, moderate distance. Phase four was vigorous jogging, long-distance, and phase five no jogging. The effects of these various exercise phases were observed immediately after treatment, one hour later, and two hours later. The results indicated that the level of inappropriate behaviour was lower when exercise occurred, even if the exercise was only warming-up (p. 482). Bachman and Fuqua reported a mean reduction in inappropriate behaviours of 20.8%. This is somewhat less than the 32.7% mean reduction reported by Watters and Watters in 1980. The authors discussed the possibility that perhaps the reductions noted in inappropriate behaviours was due to fatigue and not the effects of exercise. They suggested that future research should examine not only inappropriate behaviours, but appropriate behaviours as well.

In the first study conducted by Kern and colleagues (1982) the effects of jogging on self-stimulation, appropriate play and academic responding in seven autistic children were examined. The children jogged initially between five and ten minutes at a mildly strenuous pace. After repeated sessions, this was increased to twenty minutes. At the first sign of discomfort, the jogging was slowed to a walk. Results of this study found that jogging was an

effective means of decreasing self-stimulation and that it had a positive effect on appropriate play and academic responding.

The implications of these findings are discussed with respect to several issues. Firstly, the effects of fatigue are likely negligible since appropriate behaviours increased while self-stimulatory behaviours decreased. This inverse relationship is supported by previous research in autistic individuals (Koegel & Covert, 1972; Koegel et. al., 1974), and more specifically with blind children (Ohlsen, 1978). Secondly, the authors suggested that the jogging may directly affect appropriate responding. Research in other fields has shown this to be true (Dodson & Mullens, 1969; Schaney, Brekke, Landry, & Burke, 1976).

In the second study conducted by Kern and colleagues (1984) the effects of two modes of exercise (mild and vigorous) on the stereotypic behaviours of three autistic children were studied. The vigorous exercise consisted of fifteen minutes of jogging and the mild exercise, fifteen minutes of ball playing. Kern and colleagues (1984) found the mild exercise to have no effect on the subject's behaviour while the vigorous exercise decreased the subject's self-stimulatory behaviours.

The authors discussed the possibility that some behaviourial\physiological mechanism underlies the positive effects of exercise on stereotypic behaviours and suggested that the positive effects may be due to the possible physiological etiology of autism. Kern et al. (1984) note that despite the findings of positive effects, many educational programs do not provide brief exercise periods.

McGimsey and Favell (1988) examined the effects of exercise on the behaviour of six profoundly retarded persons in a residential facility. The exercise consisted of two 45 minute sessions. Participants were given the freedom to do as they wished provided that they moved at a fast pace. Most chose to jog. Using a multiple baseline design, the authors examined the effects of these daily exercise programs on the participant's disruptive behaviours. A decrease in the disruptive behaviours of most of the participants was noted following the jogging. For some of the participants, the exercise was not as effective. McGimsey and Favell (1988) postulated that perhaps this was due to their shorter participation, or that exercise is not an effective means for decreasing behaviours in these individuals. The authors noted that the effects of increased interaction were not controlled for in this study, and that their effects may have contributed to improvements in behaviour.

To control for this possibility, a second experiment was undertaken with four different participants (three with severe retardation, one with moderate retardation) who displayed severe aggression and hyperactivity. The experiment consisted of a baseline condition in which subjects participated in quiet activities (walking, talking) and interacted with therapists. In the exercise session, participants engaged in activities such as running, basketball, and trampolining. The results indicated that both aggression and hyperactivity behaviours decreased as a function of exercise, and not due to the increased interaction with the therapist.

Reid, Factor, Freeman, and Sherman (1988) examined the effects of a physical exercise program on the stereotypic behaviours of three adolescent males with the diagnosis of autism and pervasive developmental disorders. In addition to decreasing inappropriate behaviours, the authors were also interested in whether or not the exercise program increased on-task behaviours. The exercise program in this study consisted of 20 minutes of calisthenics, muscle-toning, and stretching. Subjects were observed prior to exercising and following exercising. Pre and post exercise scores were then compared to see if the program was effective in reducing inappropriate behaviours and increasing appropriate responding.

The results indicated that during the intervention, inappropriate behaviours decreased and correspondingly, appropriate responding increased. The increase in appropriate responding supports previous research by Kern and colleagues (1982, 1984) and negates any effects of fatigue. The authors suggested that perhaps one reason that a decrease was noted was due to the similarity between calisthenics and the movements the subjects perceive as self-stimulatory. Following the removal of the intervention, a return to baseline levels of self-stimulation and inappropriate responding occurred. In some cases, the levels were even higher than originally measured. This could be due to the removal of treatment and thus a decrease in the amount of attention the subject's were receiving. However McGimsey and Favell (1988) noted that decreases in aggressive and hyperactive behaviours occurred due to exercise and not as a function of increased interaction with the therapist.

In summary, the research has shown overwhelmingly the positive effect of exercise on reducing stereotypic behaviours. But questions concerning intensity and duration of effects still remain. The following sections examine how autistic children can engage in physical activity.

2.7 Physical Activity and the Individual with Autism

Exercise has been used as an effective means for reducing inappropriate behaviours in autistic individuals. Reid et al. (1988, p. 48) suggested five reasons as to why exercise is a beneficial intervention tool for researchers and practitioners:

1) Exercise is non-intrusive.

2) Exercise is a fun, recreational activity which may be intrinsically rewarding to some individuals.

3) Exercise provides a means for individuals to release tensions and frustrations.

4) Exercise is not cognitively demanding.

5) Exercise provides an activity which individuals can be successful at.

The exercise used in most experiments was jogging, with the exception of Kern et al. (1984) who also used ball skills and Reid et al. (1988) who used calisthenics. But are other exercises adaptable for use with the autistic individual? Killian and colleagues have shown the importance of swimming as a leisure skill which autistic children enjoy. In their first study, Killian, Joyce-Petrovich, Menna, and Arena (1984) measured the water orientation and beginner swimming skills of autistic children in order to gain objective evidence to support beliefs that autistic children enjoyed swimming. The authors found that the autistic subject responded in a normal manner to the hierarchy of water skills presented and did not object to water activities. The

authors remarked that while the subjects responded in a normal manner by performing easy tasks and objecting to more difficult tasks, the responses of the autistic children to the swimming tasks were not age appropriate. However Killian et. al., (1984) maintained that the findings supported the use of swimming activities as an avenue for learning not only physical, but social and academic skills as well.

In a follow-up study, Killian, Arena-Ronde, and Bruno (1987) examined the usefulness of two instruments which measure water orientation with atypical individuals. The atypical individuals were autistic children and youths, functionally retarded children, youths, and preschoolers, and a control group of nonhandicapped preschoolers. The authors found that a) both instruments were useful as assessment tools for practitioners, b) both instruments were appropriate for use with autistic individuals, and c) both instruments could be useful aid in education, instruction and research with autistic children.

Several authors have examined the leisure choices or patterns of autistic individuals. Hung and Thelander (1978) used a summer camp as the setting for an intensive three week program. In addition to the targeted behaviours such as self-help training, and language, the campers benefitted from physical activities such as swimming, hiking, and boating, as well as camping activities such as campfires and sing-songs. Hung and Thelander (1978) stated that

the camp setting was a potential method for providing treatment during the summer months.

Hawkins (1982) used three conditions (prompt and praise, praise anything, and token) to determine if the leisure choices of autistic children could be influenced. The leisure activities were categorized as high or low interest for each subject. In the praise anything condition the instructor played with subjects regardless of the activity chosen. After two minutes the subjects changed activity. In the token condition, subjects only received reinforcement if they played in a low interest activity for two minutes. And finally, in the prompt and praise condition, the subject was given the choice to pick an activity. If a high interest activity was chosen, the subject was ignored by the instructor for two minutes, and then encouraged to pick a low interest activity where the instructor played with the subject. Hawkins (1982) determined that the conditions which elicited the most participation in low interest activities was the prompt and praise condition.

Levinson and Reid (1991) examined the leisure activities of developmentally delayed youngsters by means of a parental questionnaire fashioned after the Canada Fitness Survey. The authors found the subjects to be relatively active with a dependency on family for leisure participation. The common activities of the subjects were walking, swimming, bicycling and

jogging/running. All of these activities involve gross motor skills which autistic individuals can achieve success. Parents felt that barriers affecting their child's participation were lack of skills, lack of facilities, and lack of leaders. Levinson and Reid (1991) noted that these results reflect perceptions and what may actually be lacking is the information about programs available.

The authors concluded by stating that the subjects in this study participated in common activities that can be used as avenues of integration and that parents must be made aware of what community facilities are available and communities must also recognize the diversity of the population they serve.

2.8 Teaching the Child with Autism

The nature of autism has been discussed, as well as some major learning characteristics, the effects of exercise, and other physical activities as they pertain to the autistic individual. But how does one teach the autistic child?

Dunlap, Koegel and Egel (1979) discussed the education of autistic children in a mainstream setting. The authors discussed issues relating to the syndrome of autism such as: self-stimulation, motivation, stimulus overselectivity, and provide suggestions on how teachers can prepare themselves for successful educational experiences.

Reid and Morin (1981) discussed the lack of information present with regard to teaching physical education to autistic children. The authors noted a lack of information pertaining to program planning, content, and performance evaluation. Reid and Morin (1981) remarked that with the trend of mainstreaming, physical educators will be required to adapt their programs to accommodate the autistic learner. To aid the physical educator, Reid and Morin (1981) briefly defined autism, discussed the characteristics associated with the syndrome, provided an overview of the motor performance of autistic children, and suggested some organizational and teaching principles. Reid and Morin (1981) stressed the importance of structured routines, the need for volunteers to maintain low teacher:student ratio, the need to reinforce meaningfully and for educators to be aware that reinforcers are very individualistic. For example, what might be meaningful with one child, may not be for another child. Other suggestions included, teaching for generalization and the need to avoid the overselectivity phenomenon by focusing the learner on relevant cues.

Schmidt, McLaughlin, and Dalyrymple (1986) provided valuable information on how to teach sport skills to autistic individuals. They stressed the importance of desensitizing the student's to the new environment as autistic learners do not adapt to new learning environments. Other suggestions included learning how the autistic

individual communicates, and establishing a routine with the student. Schmidt et al. (1986) provided an example of a progressive assistance hierarchy used by instructors teaching swimming. The components of this hierarchy can however be applied to many sport situations.

Schleien, Heyne, and Berken (1988) conducted a pilot study to determine the effects of integrating autistic children into a regular physical education program. The authors found that the integrated environment was an effective means for encouraging social play in the youngsters. As well, decreases were noted for both inappropriate play and behaviour. Schleien et al. (1988) noted that while some improvements in motor skills occurred, the lack of significant improvement could be attributed to insufficient practice time. While problems of sample size and duration existed in this pilot study, the authors nevertheless felt that the integrated physical education provided an environment which promoted motor skill development as well as social interactions.

Collier and Reid (1987) compared two models designed to teach autistic children a motor task. Specifically, the authors examined the effectiveness of a within-prompt system and an extra-prompt system on bowling. The within-prompt model reduces the prompts present in the learning environment to compensate for the overselectivity phenomenon present in autistic children. The extra-prompt model uses extensive physical, verbal and visual

prompts to aid the autistic children in learning a bowling task. The authors predicted that the within-prompt model would be the more effective instructional model. However, Collier and Reid (1987) found that the group taught with the extra-prompt model performed significantly better. Their conclusions provided physical educators working with autistic children proof that extra prompting does not deter children from learning a motor task, and that the use of prompting systems such as The Prep Play Program developed by Watkinson and Wall (1982) can be beneficial to learning.

2.9 Summary

The etiology of autism has been the focus of much research (Gillberg, 1990; Rutter & Schopler, 1987). While the theories concerning the cause of autism have changed over the years, the general belief among researchers is that autism is an organic neurodevelopmental disorder (Le Couteur, 1990). The criteria for diagnosing autism has also changed. The guidelines that exist (DSM-III-R, 1987; Ritvo & Freeman, 1978) outline the behaviourial criteria in a clear and objective manner. One characteristic of autism which has received a considerable amount of attention is stereotypic behaviours. Berkson's (1983) theory contends that stereotypic behaviours are preserved by their sensory consequences. Any attempt to eliminate these behaviours must keep this in mind.

Numerous efforts have been made to reduce or eliminate the self-stimulatory behaviours of autistic children, as these behaviours have been shown to interfere with learning (Koegel & Covert, 1972) and appropriate play (Koegel et al., 1974). The methods used include: electrical shock (Lovaas et al., 1965), overcorrection (Foxx & Azrin, 1973; Maag et al., 1986), altering environmental stimulation (Frankel et al., 1978), and redesigning the physical environment (Duker & Rasing, 1989).

One method for reducing stereotypic behaviours which is still relatively new is the use of physical exercise. Previous research has shown reductions in stereotypic behaviours following jogging (Allen, 1980; Kern et al., 1982, 1984; Watters & Watters, 1980). The questions that remain pertain to intensity of the experimental treatment and duration of effects. As well, future research needs to examine the issue of similarity in movement patterns between the exercise used and the self-stimulatory behaviours of the autistic individuals.

CHAPTER III

METHODOLOGY

The purpose of this investigation was to compare the effects of moderate versus vigorous exercise on the stereotypic behaviours of autistic children. This chapter is subdivided into the following sections: (3.1) Subject Selection; (3.2) Models of Exercise; (3.2) Control of Extraneous Variables; (3.4) Procedures; (3.5) Design; (3.6) Interrater Reliability; (3.7) Statistical Treatment.

3.1 Subject Selection

One of the most defining characteristics of the syndrome of autism is the stereotypic behaviour patterns found in all autistic individuals to a certain degree (Cushings et al., 1983; Koegel et. al., 1980). The classification system used (DSM-III-R, 1987) and the criteria outlined by the National Association for Autistic Children (Ritvo & Freeman, 1978) both make reference to these behaviours. Specifically these include: body rocking, hand and arm flapping, staring, twirling and mouthing objects, toe walking, and inappropriate speech (Cushings et al., 1983). Individuals exhibiting these behaviour patterns are said to be autistic or to have autistic-like behaviours.

For the purpose of this study the most important defining criterion was stereotypic behaviours. Prior to the experiment, a visit to a school for autistic students occurred. Observation of several classrooms yielded a sample of three low functioning subjects with high levels of stereotypic behaviours. All three subjects had been referred to the school by independent neurologists and had been classified as autistic based on the criteria outlined in the DSM III. A list of stereotypic behaviour patterns was assembled by reviewing previous research (Kern et al., 1982; 1984, Watters & Watters, 1980) and with the aid of the classroom teacher and shadows of each subject, an outline of the stereotypic behaviours exhibited by each subject was compiled (Appendix A, B, C). The directrice of the school confirmed the classification of autism for all three subjects.

The subjects were enroled in a special education school in Montreal and lived at home. The school in question was specifically designed for the autistic learner. A physical education program was provided once a week at the school. In addition to this, going outside for exercise was already part the students daily program.

3.1.1 Profile of Subjects

Subject one (male): Age at time of testing: 11 years. This subject had attended a school for autistic students for five years. Specific behaviours included: a) intense staring, gazing at hands; b) self-stimulation (saliva fingering, body rocking, finger flexing, rotation of eyes); c) self-injurious behaviours (pulling hair, biting hands, running); d) inappropriate speech (spontaneous vocalization, laughing, and clucking).

Subject two (male): Age at time of testing: 11 years. This subject had attended a school for autistic students for five years. Specifics behaviours manifested by subject two included: a) intense staring; b) self-stimulation (tensing of body, shaking of head and body, jabbing); c) inappropriate speech (delayed echolia, giggling, screaming, repetition of words); d) self-injurious behaviour (biting of hands). Five weeks into the experiment, subject two started taking 10mg of Anaphranil to control compulsive behaviours.

Subject three (female): Age at time of testing: 11 years. This subject had attended a school for autistic students for seven years. Specific behaviours included: a) intense staring; b) self-stimulation (flapping of hands, body rocking); c) inappropriate speech (laughing, screaming, snorts); d) self-injurious behaviours (biting, hitting, and kicking).

3.2 Models of Exercise

There were two treatment conditions in this investigation: a) a moderate exercise program, and b) a vigorous exercise program. The two programs differed with regard to intensity.

3.2.1 The Moderate Exercise Program

The moderate exercise program was designed to provide exercise that would be beneficial, but not require maximum effort on the part of the subjects. Specifically each session lasted fifteen minutes and consisted of walking.

3.2.2 The Vigorous Exercise Program

The vigorous exercise program consisted of eliciting optimum effort on the part of the subjects. This was accomplished by a brisk fifteen minute jog. As much as possible, the subjects were encouraged to keep jogging by having a shadow run with each subject. If however, the subject began to show signs of distress, such as strained breathing, the pace was slowed to a walk to allow the subject to rest while not completely stopping the activity. The walking pace was maintained however at a vigorous level.

The vigorous exercise program was modelled after programs used in previous research (Kern et al. 1982; Kern et al., 1984; Watters & Watters, 1980). Previous studies found a decrease in stereotypic behaviours following the vigorous exercise program. Only one of

the studies included a mild exercise program consisting of a manipulative task (Kern et al., 1984). The mild exercise was found not to have any effects on the behaviours of the subjects. The inclusion of a moderate exercise program in this study differed from that of Kern and colleagues (1984) in that this program did not involve a manipulative task (ball playing) but similar to the jogging condition, utilized a whole body involvement approach. It has been hypothesized by Reid et al. (1988) that these whole body movements imitate the movements used by autistic individuals to self-stimulate and thus are effective means of reducing stereotypic behaviours.

3.3 Control of Extraneous Variables

Certain difficulties shown by autistic individuals interfere with task performance. Specifically, lack of motivation and reactions to change have been a concern in previous research. In the following section, these areas of concern are addressed along with the means that were used to minimize their effect.

3.3.1 Adverse Behaviourial Reactions to Novel Environments

When autistic individuals are presented with novel milieus (location, tasks, instructors) it has been observed that they react adversely and behave inappropriately (Runco et al, 1986). To minimize this potential problem, the following steps were taken:

1) The subjects were familiar with the instructor through three two hour visits. All three visits took place in the subject's classroom. The visits happened within a two week time period prior to testing, and on separate days. As well, the classroom teacher and shadows were present.

2) In every instance, testing occurred in an environment familiar to the learner. This environment remained the same across trials for all subjects.

3.3.2. Lack of Motivation

Another concern was the lack of motivation frequently exhibited by autistic individuals. This behaviour is manifested by inappropriate or off-task behaviour and infrequent task attempts (Dunlap & Koegel, 1980; Egel, 1980). In order to maximize interest and participation, the following procedures were employed:

1) For the duration of both exercise periods (moderate and vigourous), a shadow (person familiar to the subject) accompanied the subject, to prevent the subject from stopping.

2) This same individual as well as the experimenter constantly reinforced each subject for participation.

3.4 Procedures

This investigation consisted of three phases: The first was an observational period during which the investigator observed all subjects in the classroom environment for the purpose of establishing a baseline of stereotypic behaviours. The second part of the study was the administration of the two experimental conditions, the moderate and vigorous exercise programs to all three subjects. The third phase was another observational period, identical to the first.

Two settings were employed for this investigation: 1) a large open field and 2) a classroom. The physical activity sessions (moderate and vigorous) took place in a large open field located just outside the school. The baseline measures, and all recordings of stereotypic responses preceding and following each exercise period, occurred in the classroom.

3.4.1 First Observational Period

The initial observation of subjects took place over three two hour periods, with all observations occurring in the classroom. These observations were on separate days within a two week period prior to the commencement of the experimental program. Subject observation occurred for the following reasons:

1) Familiarization with subject's behaviour patterns and frequency of these behaviours in order to establish a stable baseline.

2) Observation of specific techniques by which attention and performance were elicited, to facilitate the experimental phase by using the techniques which would optimally be effective for a given subject.

3) Familiarization of the subject with the researcher.

Interval-sampling is an assessment measure frequently used in applied behaviour analysis (Wall, 1981). It involves the recording of behaviour during a specified time period which is usually divided into shorter intervals. In the present study, an interval-sampling procedure similar to that of Kern and colleagues (Kern et al., 1982, 1984) was utilized. Each session was videotaped. The order in which the subjects were viewed was randomly selected but a cyclical pattern was established for each session. For example, for a given session the pattern was a follows: subject 1 was videotaped for one minute, then subject 2 for one minute, then subject 3, then subject 1, etc...

Each minute was divided into four 15 second intervals. A continuous recording procedure was used. It was felt that viewing and recording could be done concurrently. The presence of stereotypic behaviours was noted on data sheets (see Appendix D).

The stereotypic behaviours were subdivided into three categories: Motor, Verbal and Other. These subdivisions were established to determine if some stereotypic behaviours were more common than others and differentially affected by exercise. The designation of a specific stereotypic behaviour as either motor, verbal or other was achieved by an expert in the area of autism who reviewed the list of stereotypic behaviours prior to the beginning of the study. To establish the validity of this categorization, another individual naive to the experiment and to the syndrome of autism repeated the procedure.

3.4.2 Administration of Experimental Conditions

As going outside for exercise was a part of each subjects program at school, it was not necessary to obtain consent from the principal caregiver for going outside. Approval was however obtained for videotaping the subjects.

Each experimental session began with a pre-exercise observational period of 45 minutes in order to establish the frequency with which the subjects showed stereotypic behaviour patterns on that particular day and thus to assess the reliability of the baseline measures previously obtained. Following the 45 minute observational period, the subjects were taken outside and depending on the session, either the moderate or vigorous exercise program was implemented for fifteen minutes. After the exercise

program, the subjects returned to their classroom, and continued with regularly scheduled activities. During the post-exercise time, the experimenter observed for forty-five minutes, using the same observational schedule noted previously. At the end of the forty-five minutes, each shadow was given a brief questionnaire (Appendix E & F) concerning how his/her subject behaved following the exercise. The shadows were asked to rate the interest, mood, state of relaxation, level of self-stimulation, motivation and level of fatigue of the subject (on a scale of 1 to 5). To eliminate biased answers, the shadows were blind to the hypotheses of the experiment. A final observation session on a given day occurred one and a half hours following the initial implementation of the treatment. This observational period lasted thirty minutes and occurred after the subjects had eaten their lunch. While the subjects were supervised during lunch, there was no formal structure. The reasoning behind this session was to establish the duration of postulated decreases in stereotypic behaviours. While some research has observed the duration of effects (Allen, 1980; Bachman & Fuqua, 1983) most research has only examined the immediate effects of exercise on self-stimulatory behaviours (Kern et al., 1982, 1984; McGimsey & Favell, 1988; Reid et. al., 1988; Watters & Watters, 1980).

Intervention in the manner described above occurred twice a week for five weeks. The moderate and vigorous exercise programs were each administered alternatively once a week. Differentiation between the moderate and vigorous exercise programs was based on heart rate. The subjects' pre exercise heart rates were determined prior to going outside and their post-exercise heart rates immediately following exercise. This was done by the experimenter monitoring the radial pulse for 10 seconds.

3.4.3 Second Observational Period

Following the five week exercise phase, the subjects were observed once again in their classroom environment. This second observation period (a return to baseline conditions) was included to note if any increases in stereotypic behaviours occurred due to the withdrawal of the exercise interventions. Four visits of two hours each occurred.

3.5 Design

The experimenter administered both the moderate and vigorous models of exercise. All three subjects participated in both exercise conditions. As mentioned earlier, prior to any visits, a list of stereotypic behaviour patterns for each individuals was compiled. Stereotypic behaviour levels for each subject were determined during the initial observational period, prior to

administration of the exercise programs. Immediately preceding and following each exercise bout in the experimental phase, the experimenter recorded levels of stereotypic behaviour. After the termination of the five week exercise programs, a second observational period was included to reassess levels of stereotypic behaviour. The dependent variable in this investigation was the frequency with which the subject engaged in stereotypic behaviours. Based on the interval-sampling observational-recording scheme described above, the presence of a stereotyped behaviour was recorded for each subject and frequency of involvement determined.

3.6 Interrater Reliability

In order to establish the reliability of the primary observer, a secondary observer independent of the experiment was involved. The second observer was familiar with the syndrome of autism but unfamiliar with the subjects as well as blind to the hypotheses of the experiment. The secondary observer viewed four tapes from the session, one from initial baseline, one from the walking condition, one from the jogging condition, and one from the second baseline. As well, the secondary observer viewed an additional tape to determine the reliability of the subdivisions of the stereotypic behaviours into motor, verbal and other.

Prior to the secondary observer viewing any session, a training session occurred where she was briefed on the observational schedule to be used and was given a list of the stereotypic behaviour patterns exhibited by each subject.

3.7 Statistical Treatment

Frequency of occurrence was the main dependent measure in this investigation. This is the proportion of recording intervals in which a given subject engaged in stereotypic behaviours patterns (Parsonson & Baer, 1978). Visual analysis of graphs was employed in order to determine whether the exercise programs were effective in decreasing these behaviours. As well, a multivariate analysis of varinance was used to determine the statistical significance of any differences which occurred between the walking and jogging treatment.

CHAPTER IV

RESULTS AND DISCUSSION

The purpose of this study was to examine the influence of different intensities of exercise on the stereotypic behaviours of autistic individuals and the duration of these effects. The present chapter is divided into the following sections: (4.1) Inter-rater Agreement of Stereotypic Behaviours, (4.2) Distances and Intensities of Exercises, (4.3) Treatment Effects, (4.4) Perceptions of Treatment Effectiveness: Response from Shadows, (4.5) Duration of Treatment Effects, and (4.6) Statistical Significance of the Effects of Treatment.

4.1 Inter-rater Agreement of Stereotypic Behaviours

An inter-rater agreement score was calculated by having two observers record the occurrence of stereotypic behaviours. The primary observer recorded the stereotypic behaviours of each subject for all sixteen sessions during initial baseline, treatment, and the final baseline. The secondary observer recorded 25% of the sessions, one session from the initial baseline, one session from each treatment, and one session from the final baseline. An agreement consisted of both observers recording the same number of responses. Percent agreement was calculated separately for each session by dividing the number of agreements by the number of agreements plus the number of disagreements. The average percent agreement was 85%, (70%, 85%, 90%, and 95%).

In addition, the secondary observer viewed one extra tape to determine the reliability of the classification of the stereotypic behaviours as either motor, verbal or other. Percent agreement was calculated in a similar manner as noted above. The percent agreement was 75%. While the agreement is not as high as those previously obtained, the differentiation of the stereotypic behaviour among each individual was not always clear cut. Had the secondary observer been familiar with the subjects, but still naive to the purpose of the study, a higher percent agreement might have been achieved.

4.2 Distances and Intensities of Exercise

The two treatment sessions (walking and jogging) were designed to be differentiated on the basis of intensity measured by heart rate and by distances covered in fifteen minutes. Table 1 includes pre exercise and post exercise heart rates (over 60 seconds) as well as the distance covered in metres for the walking sessions. Table 2 includes the same information for the jogging sessions.

Table 1: Heart Rates and Distances for the Walking Treatment

	SUBJECT						
	1		2		3		dist
SESSION	Pre*	Post**	Pre	Post	Pre	Post	(m)
1	72	96	84	102	72	90	3401.4
2	78	96	84	108	72	90	3401.4
3	72	108	72	108	72	114	3401.4
4	84	108	108	120	78	120	3401.4
5	78	90	84	120	72	90	3401.4
mean	78	102	84	114	72	102	3401.4

*pre HR over one minute immediately prior to exercise.

**post HR over one minute immediately following exercise.

Table 2: Heart Rates and Distances for the Jogging Treatment

	SUBJECT						
	1		2		3		dist
SESSION	Pre*	Post**	Pre	Post	Pre	Post	(m)
1	72	126	78	120	66	138	4635.4
2	72	180	90	180	108	168	5620.7
3	78	150	78	180	90	168	6155.1
4	90	126	96	138	***	***	6155.1
mean	72	144	84	156	90	156	5641.6

*pre HR over one minute immediately prior to exercise.

**post HR over one minute immediately following exercise.

***only present for three sessions

From the results noted in Table 1 and 2 the two treatments can be differentiated by intensity. Examining the average post-exercise heart rates of the three subjects, it is apparent that those occurring in the walking sessions are lower (102, 114, 102 beats per minute) than those in the jogging sessions (144, 156, 156, beats per minute). As well, the distances covered in metres during the fifteen minutes of treatment are greater for jogging than for walking. Thus it is possible to state that the jogging condition was of a higher physical intensity than the walking condition.

4.3 Treatment Effects

4.3.1 Moderate Exercise Treatment

It was hypothesized that significant decreases in stereotypic behaviours would occur with vigorous exercise only. Figure 1 provides an overall view of changes in frequency of behaviours that occurred throughout the nine weeks. Examining only the walking segments it can be seen that indeed, walking did not decrease self-stimulation. Rather, in two of three cases, a slight increase in the frequency of behaviours was apparent.

Figure 2 illustrates subject one's responses to treatment. The subject's overall baseline level of self-stimulation was 69.5% (range 58% - 77.2%). This increased slightly to 73% (range 56.8% - 84.4%) for the subject's pre walk level. Post walking recordings

indicated that the subject was involved in self-stimulatory behaviours 77.3% (range 67.9% - 88.9%) of the time observed. This further increased to 87.5% (range 79.2% - 95.8%) in the after lunch section.

Subject two followed a similar pattern, shown in Figure 3. Baseline observations averaged 69.3% (62.1% -75%) which increased to a pre-walk level of 77.1% (range 65.4% - 92.5%). This subject was found to be self-stimulating 81.4% (range 66.7% - 90.1%) of the time in the post walk section. Again, in the after lunch segment a large increase to 92% (range 88.1% - 100%) involvement in stereotypic behaviours was noted.

In Figure 4 subject three was found overall to be occupied in self-stimulatory behaviours 71.2% (range 66.3% -74.2%). In the pre-walk condition this level remained consistent at 70.2% (range 60% - 83.3%). In subject three's case, a decrease to 66.4% (range 57.6% -78.1%) in the frequency of stereotypic behaviours occurred. After lunch subject three's level of involvement in behaviours increased to 86.5% (range 80% - 100%).

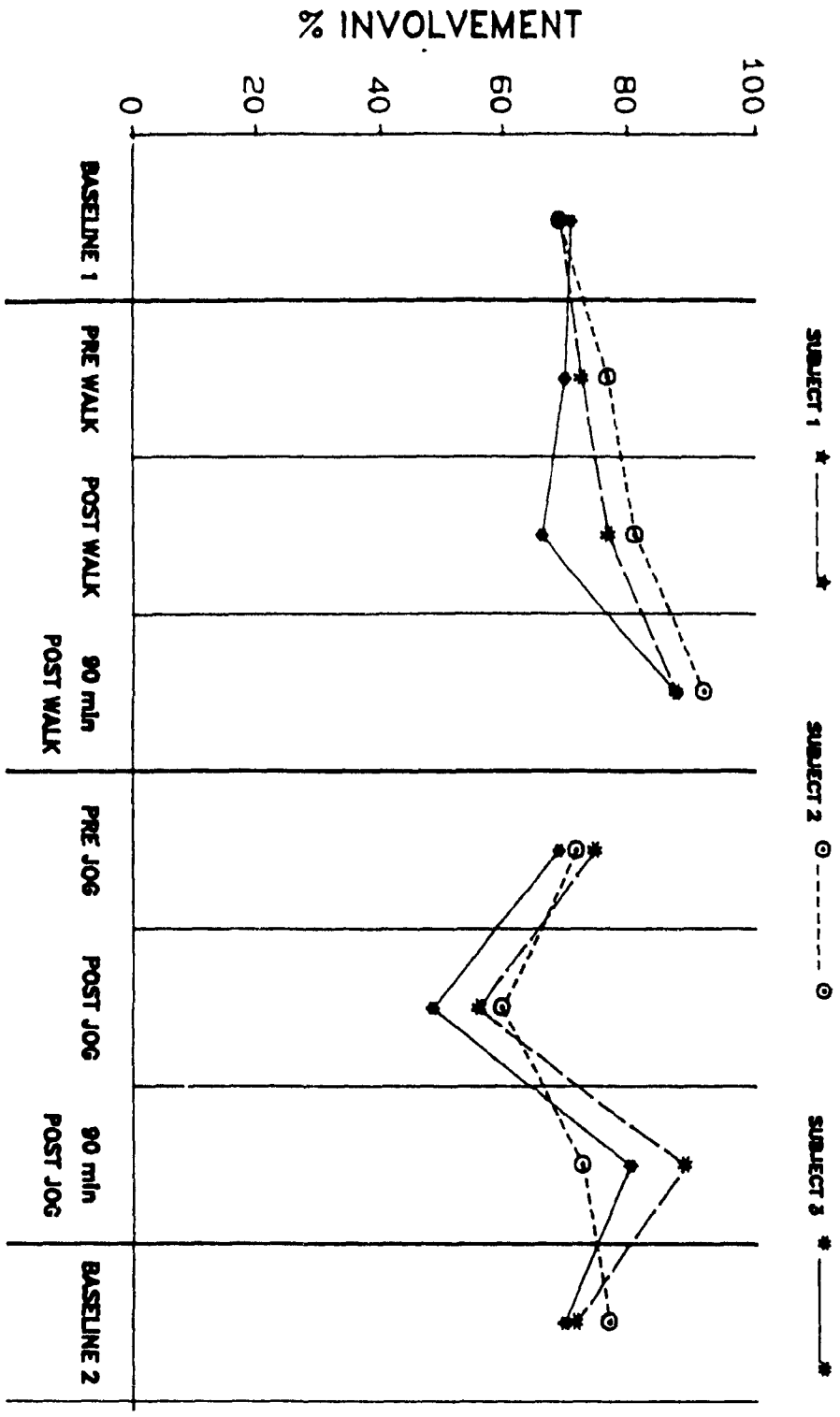

Figure 1: Percent Involvement in Stereotypic Behaviours for Subjects

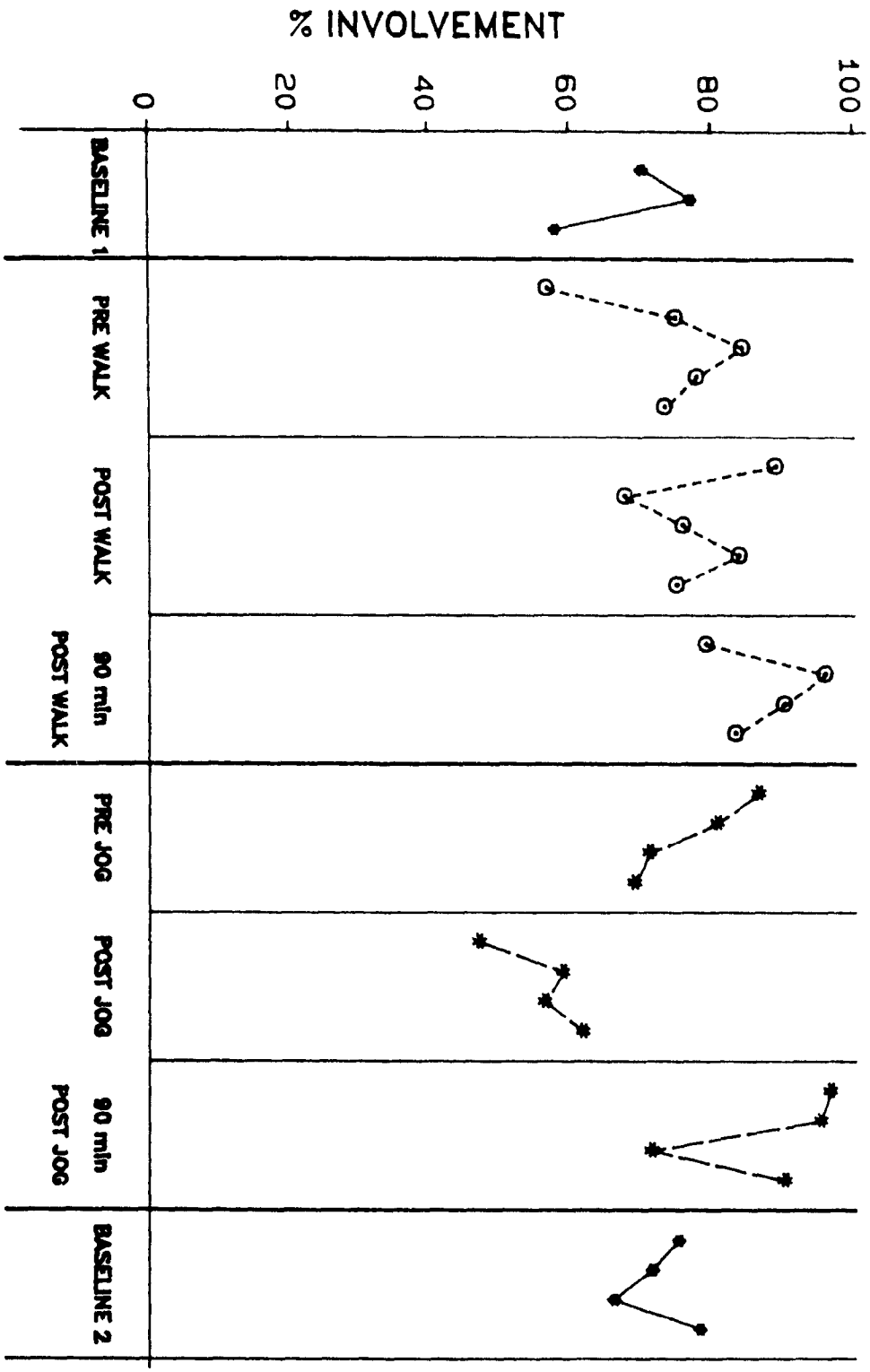

Figure 2: Percent Involvement in Stereotypic Behaviours for Subject 1

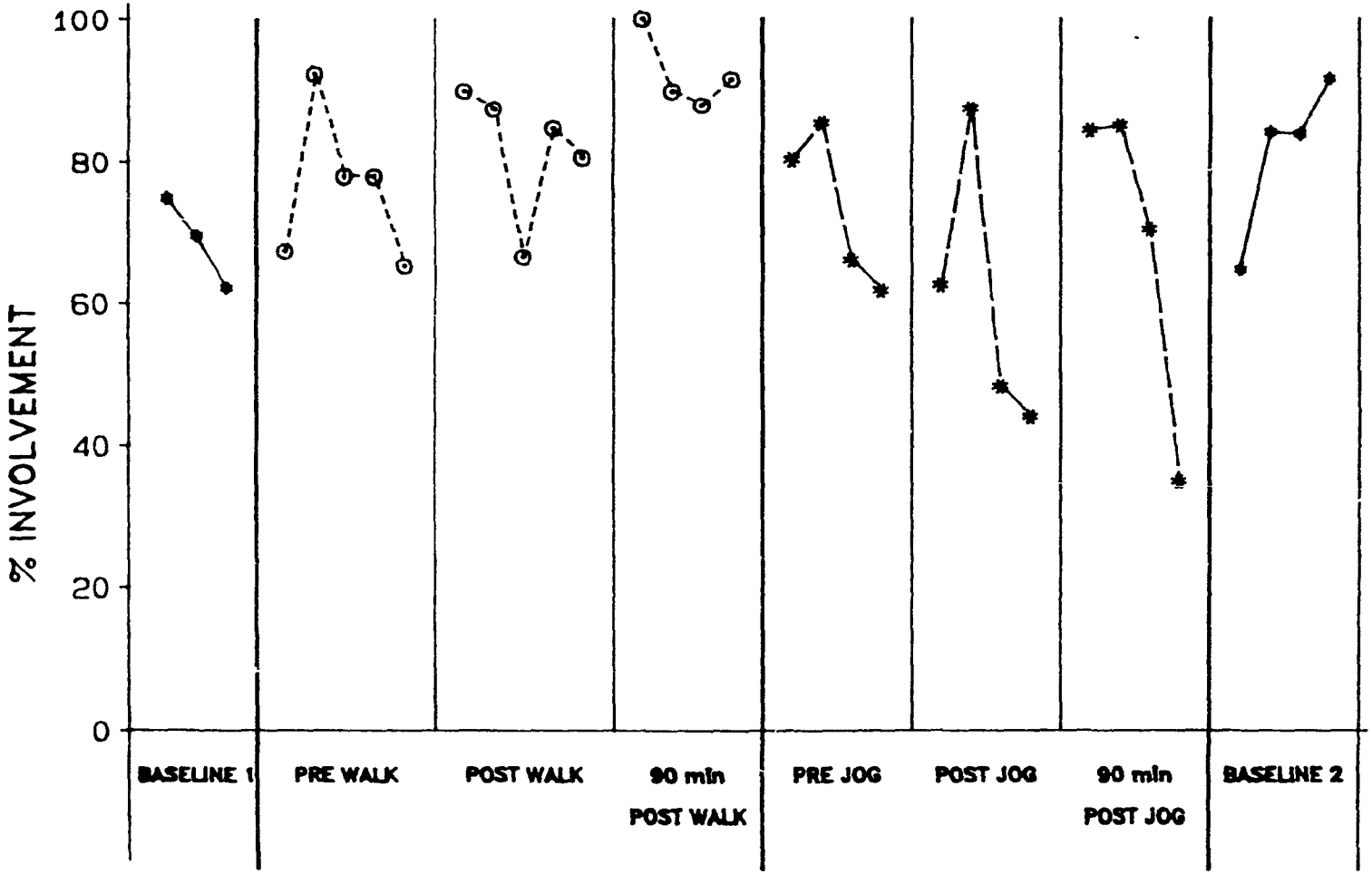

Figure 3: Percent Involvement in Stereotypic Behaviours for Subject 2

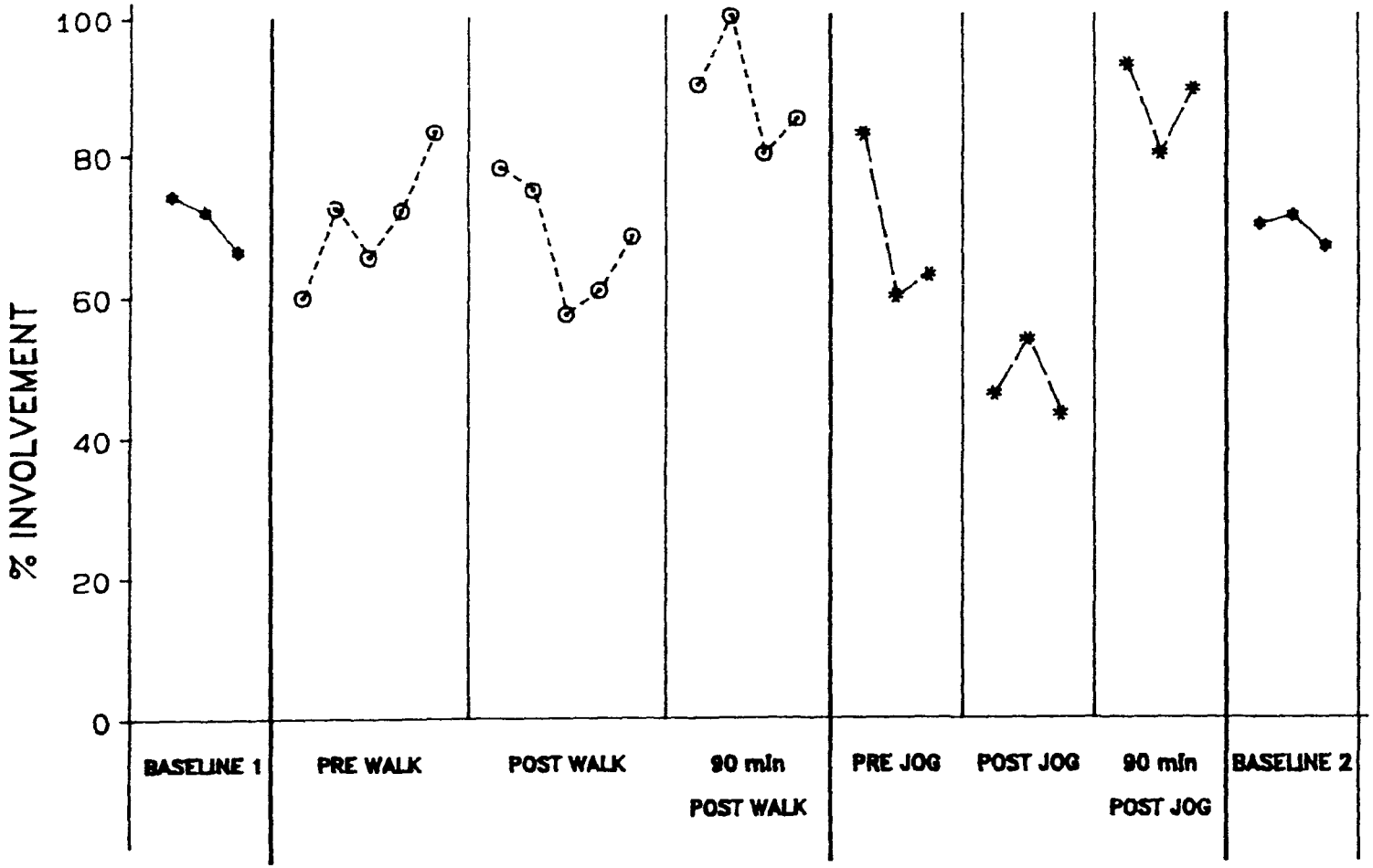

Figure 4: Percent Involvement in Stereotypic Behaviours for Subject 3

For all three subjects, increased levels of stereotypic behaviours were noted in the after lunch sessions. As previously mentioned, there was no formal structure given to the subjects in this session. Rather they were supervised in their classroom and allowed to engage in any behaviours they wished as long as they were not dangerous ones. Previous research has shown that when autistic children are left in a room with toys, little appropriate play occurs (Koegel et al., 1974). Instead, self-stimulatory behaviours are noted, and such is the case in the after lunch sessions.

Kern and colleagues (1984) examined the effects of mild versus vigorous exercise on the stereotypic behaviours of autistic individuals. While their study used a different activity for the mild exercise, (ball playing as opposed to walking), the results were similar. Kern et al. (1984) found no systematic decreases in the stereotypic behaviours of the individuals following the mild exercise session.

Bachman and Fuqua (1983) used different exercise intensities in their study to examine the effects of exercise on inappropriate behaviours. The various conditions in their study ranged from stretching to vigorous jogging. They found that as the level of physical exertion increased, a corresponding decrease in the level of inappropriate behaviour was noted. These results further support the present findings of the differential effects of exercise intensity.

In contrast to the above studies, the present study was more stringent in its differentiation between the two exercise intensities. The intensity of each exercise condition was monitored by heart rate and by distance covered. The activity chosen to be representative of moderate and vigorous exercises is an important distinction previously discussed in the review of literature. The activities of the present study (walking and jogging) utilized similar movements, while the activities employed by Kern et al. (1984) (ball playing and jogging) did not involve similar movements. The results achieved by both studies were similar. Thus the present study has succeeded in confirming previous results with a more rigorous definition of moderate versus vigorous in terms of intensity, and with a more appropriate choice of activity.

4.3.2 Vigorous Exercise Treatment

Previous research has stated that decreases in stereotypic behaviours are noted following exercise (Allen, 1980; Watters & Watters, 1980; Kern et al., 1982, 1984). In this study it was hypothesized that decreases in stereotypic behaviours would occur with vigorous exercise only.

Referring to Figure 2, one notes that subject one's pre jogging level of self-stimulation was 75% (range 69.1% - 86.5%). This decreased to 55.7% (range 47.2% - 61.8%) following jogging, only to increase to 88.8% (range 71.4% - 96.4%) after lunch. The

final baseline measure for subject one was 71.9% (range 66% - 78%.1), similar to the initial baseline.

In Figure 3 a similar pattern was noted for subject two. Pre-jogging self-stimulation occurred 72.0% (range 61.8% - 85.4%) of the time. Post-jogging levels were lower at 59.8% (range 44% - 87.5%), with an increase to 73.0% (range 35% - 85%) after lunch, and a final reading of 77.3% (range 64.6% - 91.7%) was recorded as a final baseline measure. While an overall decrease in stereotypic behaviours for subject two was noted following the jogging condition, the wide range of frequencies needs to be expanded upon. A value of 87.5% was recorded in the second post-jogging session. On that particular day, subject two was extremely bothered and the treatment was ineffective in reducing his level of stereotypic beh-viour.

Similar to subjects one and two, subject three's overall percentages reflect what was hypothesized. In Figure 4 it is noted that the subject's pre-jogging level was 69.0% (range 60% - 82.8%) which decreased to 48.1% (range 43.3% - 53.9%) following jogging. After lunch the level of stereotypic behaviour increased to 86.5% (range 80% - 92.9%) and with the withdrawal of all treatment subject three's level of self-stimulation returned to a baseline value of 69.9% (range 66.7% - 71.1%). The effects of the jogging treatment were found to be significant ($P < .001$) by means of a multivariate analysis of variance (Appendices G & H).

For both experimental conditions, a pre-exercise observational period was included in order to establish the frequency with which the subjects demonstrated stereotypic behaviour patterns on that given day, as well as to assess the reliability of the initial baselines measure previously obtained. The final baseline measure was included to note if withdrawal of the exercise interventions resulted in increases in stereotypic behaviours. The data obtained for these four sessions were as follows: subject 1: initial baseline 69.5%, final baseline 71.9%, subject 2: initial baseline 69.3%, final baseline 77.3%, subject 3: initial baseline 71.2%, final baseline 69.9%. While there were some increases in frequency as seen with subject 2, overall the discrepancies were slight and the similarity between the frequencies obtained for each session reinforced the accuracy of measurement of stereotypic behaviours in the present study.

The mean reduction of stereotypic behaviours between pre jogging and post jogging sessions was 17.5% with a range of 12.2% to 20.9%. Previous research has noted mean decreases in level of self-stimulation following jogging of 32.7% (Watters & Watters, 1980) and 20.8% (Bachman & Fuqua, 1983). Kern et al. (1982) found that jogging at a mildly strenuous pace decreased levels of self-stimulation and positively affected appropriate play and academic responding. Watters and Watters (1980) also noted the positive influence of exercise on correct responding.

Allen (1980) examined the effects of no jogging, 5 minutes of jogging, and 10 minutes of jogging. The teachers of the students noted that they were less disruptive in class following the 10 minute jogging sessions. This further supports the contention that for positive behaviourial changes the exercise intensity is critical.

Reid et al. (1988) hypothesized that the decrease in inappropriate behaviours was due to the similarity in movement between the exercise program and the subject's self-stimulatory behaviours. The calisthenics and stretching thus provided the same stimulation for the subjects, but in an appropriate setting. This supports the beliefs of Berkson (1983) who proposed a "self-stimulation" theory which argued that the stereotyped behaviours exhibited by autistic individuals were maintained by the sensory input of the movements. Berkson (1983) stated further that when attempting to reduce the stereotypic behaviours of an individual, the alternative activity presented must provide the same sensory input. The present study attempted to take the issue of providing alternative sensory stimulation by using two activities with similar gross motor movements to examine the issue of effects of intensity. Results indicated that the vigorous nature of jogging resulted in greater decreases in inappropriate stereotypic behaviours among all three subjects.

4.3.3 Differentiation between Motor, Verbal and Other Stereotypic Behaviours.

The differentiation between motor, verbal and other stereotypic behaviours was done to see if specific actions typical of autistic individuals were affected by mild or vigorous exercise, or if certain stereotypic behaviours were more common than others to autistic individuals. For example, following exercise does body rocking (a motor component) decrease, while clucking (a verbal component) increase? Figures 5, 6, and 7 illustrate the influence of duration of the moderate exercise program on the specific components of each session in each category, while Figures 8, 9, 10 illustrate the influence of the vigorous exercise program on the specific components. The sum of each component does not equal the overall frequency as it is possible for a given individual involved in self-stimulatory behaviours to be body rocking (motor) and clucking (verbal) simultaneously. In general, two of the subjects were involved in motor and verbal stereotypic behaviours, while the third subject had a higher frequency of motor stereotypic behaviours.

Moderate Exercise Program

From these figures one can see that the three components (motor, verbal, and other) are not differentially affected by the moderate exercise intervention. However when unusual decreases occurred in one component, compensatory increases occurred in the

other two components resulting in the maintenance of the overall level of stereotypic behaviours. Previous research has shown that when one self-stimulatory behaviour is suppressed, another behaviour emerges as dominant (Harris & Wolchik, 1979; Rollings, Baumeister & Baumeister, 1977). An illustration of this tendency is evident in Figure 5 in the first post-walking session of subject one. A high level of stereotypic behaviour (88%) was noted. There was a suppression of subject's motor component from a pre-walk mean frequency of 51.7% to the post-walk level of 22.2%. However, an increase is noted for the verbal and specifically the other stereotypic behaviour component thus maintaining the subject's level of self-stimulatory behaviours. Overall, an increase from 51.7% in the pre walk condition to 53.6% in the post walk condition was noted for subject one.

In summary, the walking condition was found to have no significant effects on the overall frequency of stereotypic behaviours for all three subjects. For subject one, the motor component of stereotypic behaviours increased, while the verbal component remained the same. In subject two's case, increases were noted in both the motor and verbal components following walking. Only in subject three's case were overall decreases in the frequency of motor component of stereotypic behaviours noted.

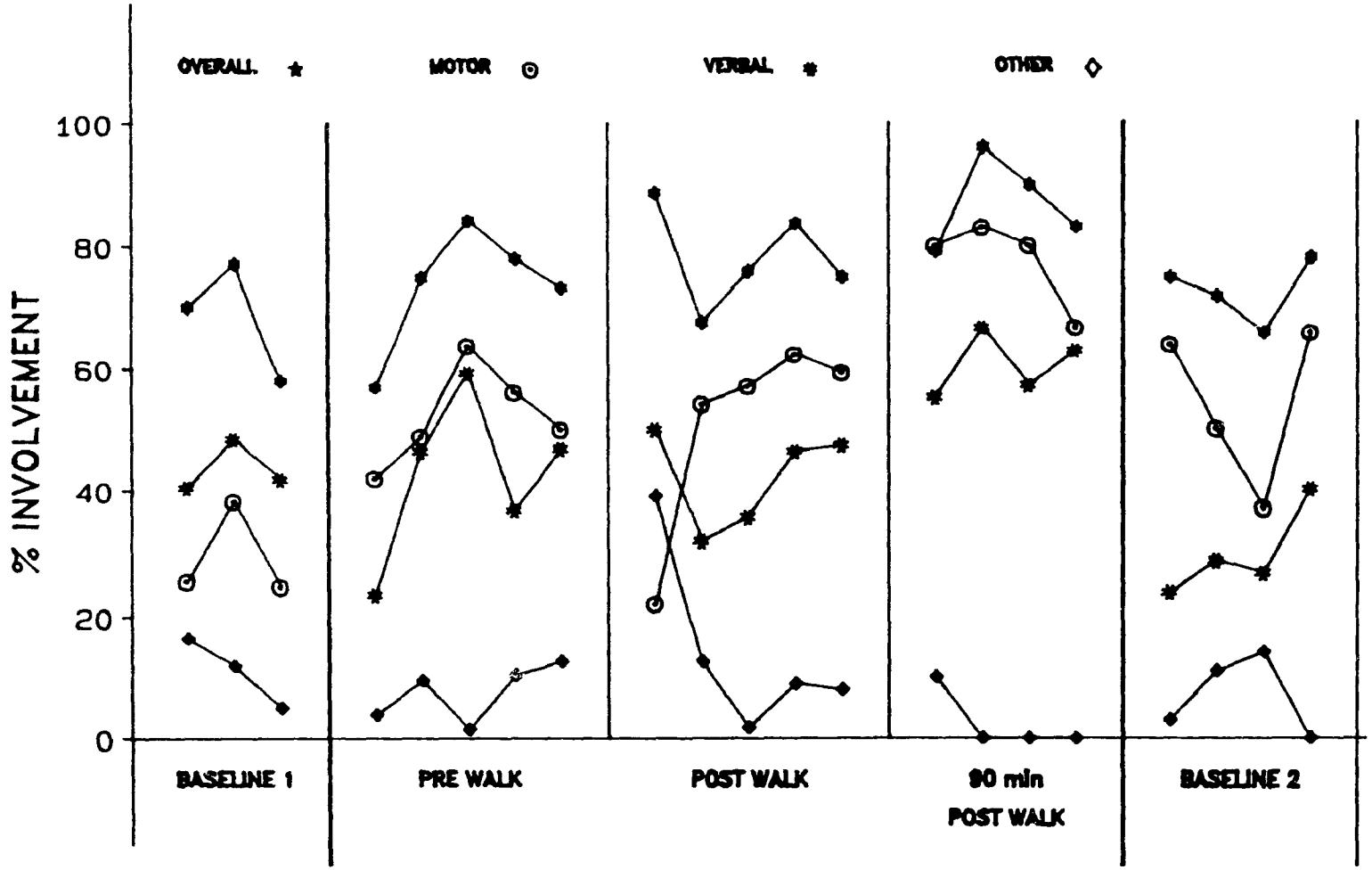

Figure 5: Components Involved in Stereotypic Behaviours for Subject 1 - Walking Condition

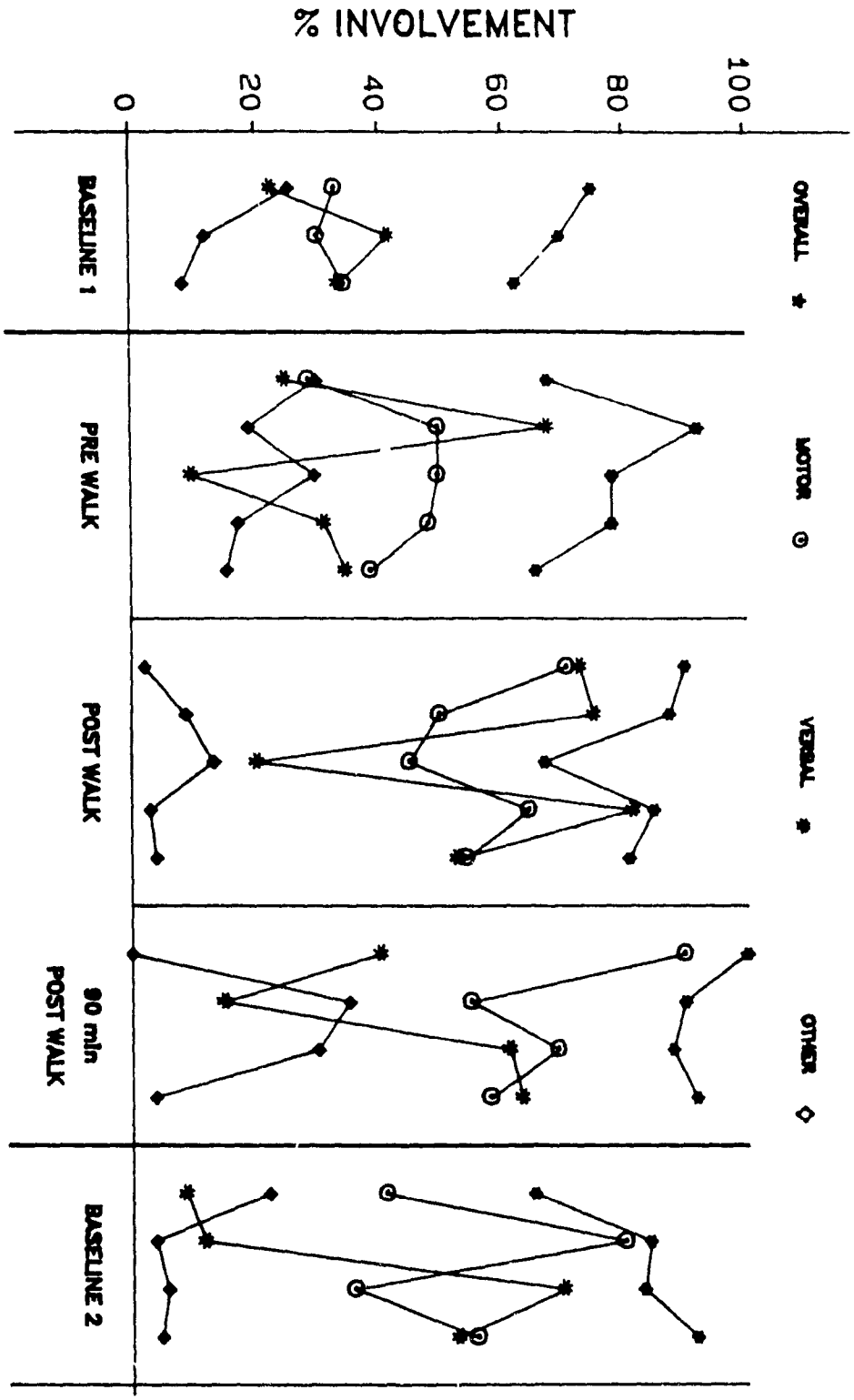

Figure 8: Components Involved in Stereotypic Behaviours for Subject 2 - Walking Condition

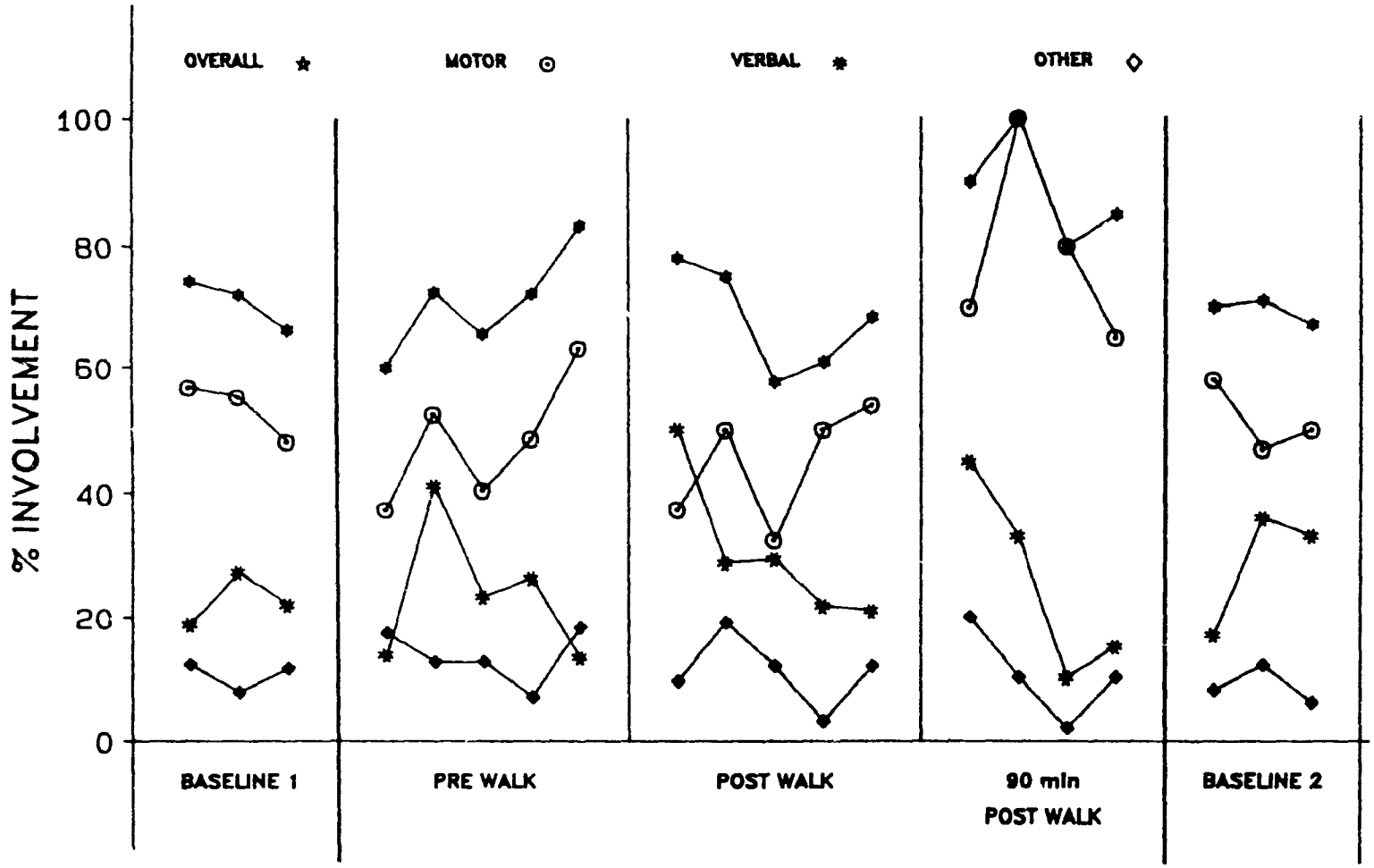

Figure 7: Components Involved in Stereotypic Behaviours for Subject 3 - Walking Condition

Vigorous Exercise Treatment

The effects of jogging on the differentiation of the stereotypic behaviours are depicted in Figures 8, 9 and 10. In all three subjects, the component of behaviour which consistently decreased following jogging was motor. In subject one the motor pre-jogging level was 51.8%, while the post jogging level was 29.9%. The same results were found for subject two (pre - 42.8%, post -35.5%) and subject three (pre - 50.5%, post - 28.8%).

While the vigorous exercise appears to have the greatest influence on the motor component of these subject's stereotypic behaviours, the verbal component was affected to some extent. Subject one's pre jog level of verbal self-stimulation was 40.2%, while the post jog level decreased to 28.7%. With subject two the pre jog verbal level was 25% This increased to 41.3% in the post jog session. The vigorous exercise program had no effect on subject three's verbal component. The pre-jog level noted in Figure 10 was 21.7% and the post jog level remained relatively constant at 18.9%

One extreme score is noted in Figure 9 where subject two displayed unusual high levels of verbal stimulation in both the pre jogging (58.3%) and post jogging (76.6%) sessions. Overall the subject's level of self-stimulatory behaviours increased with a decrease in the motor component occurring (56.3% pre jog to 39.1% post jog).

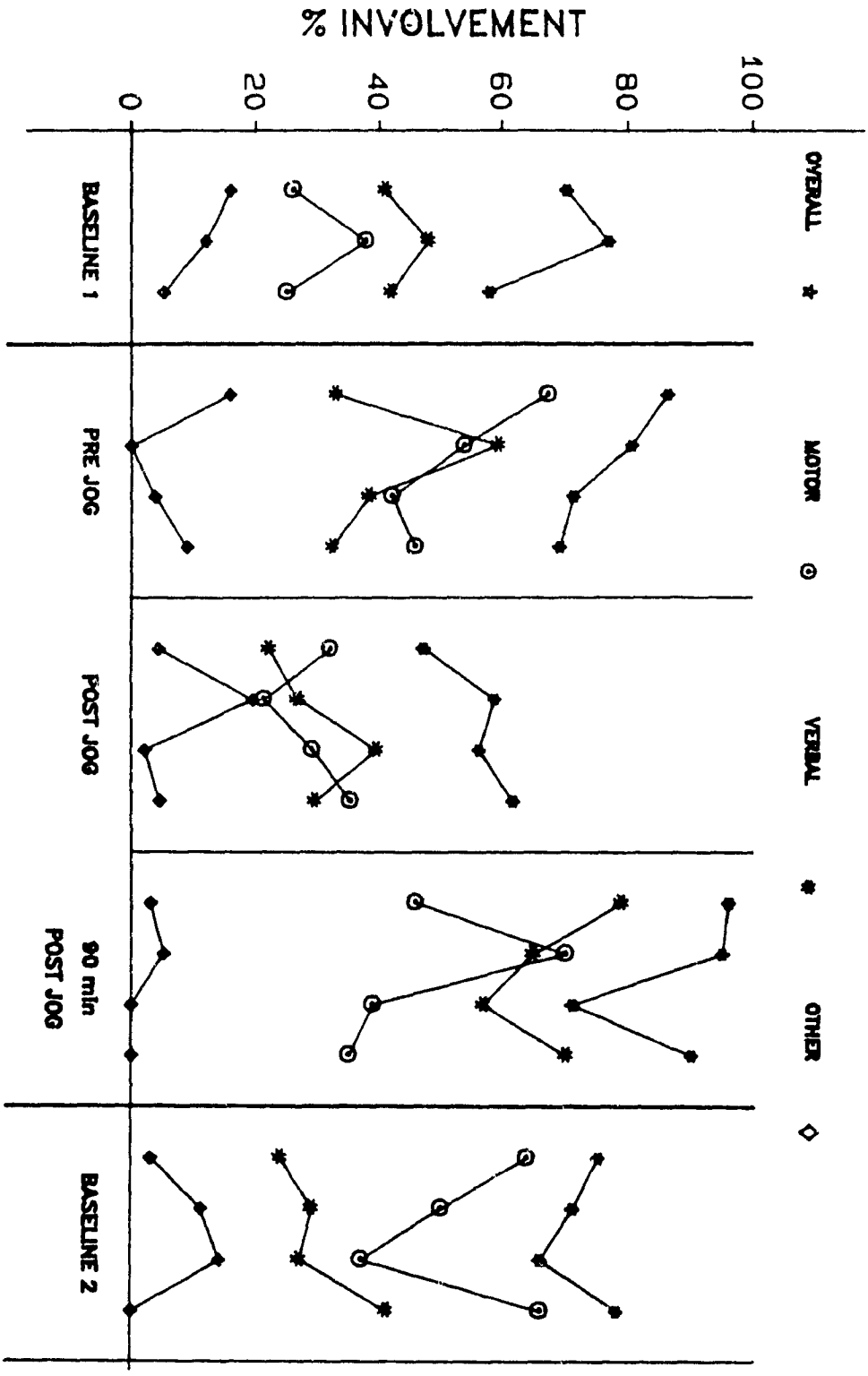

Figure 8: Components Involved in Stereotypic Behaviours for Subject 1 - Jogging Condition

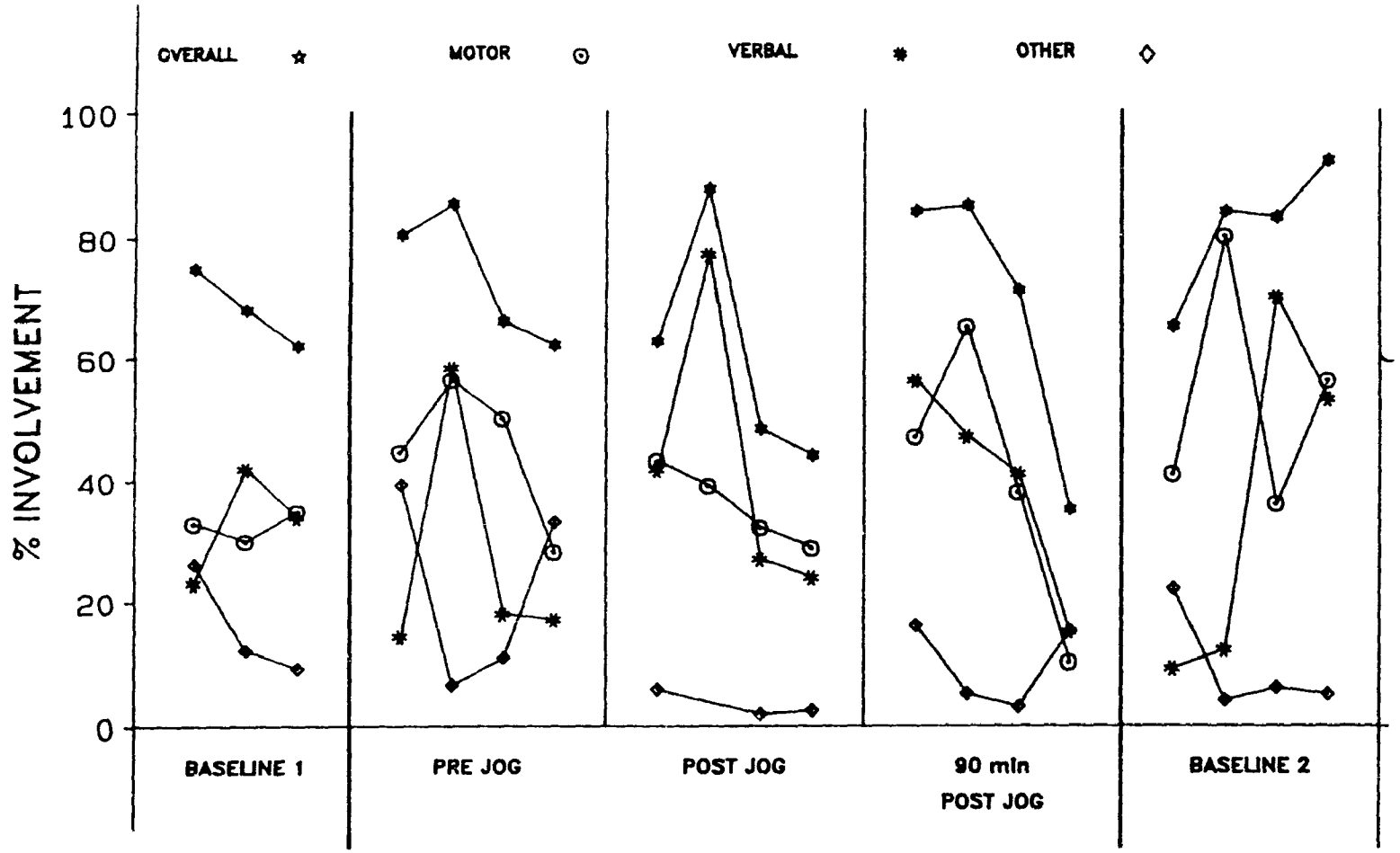

Figure 9: Components Involved in Stereotypic Behaviours for Subject 2 - Jogging Condition

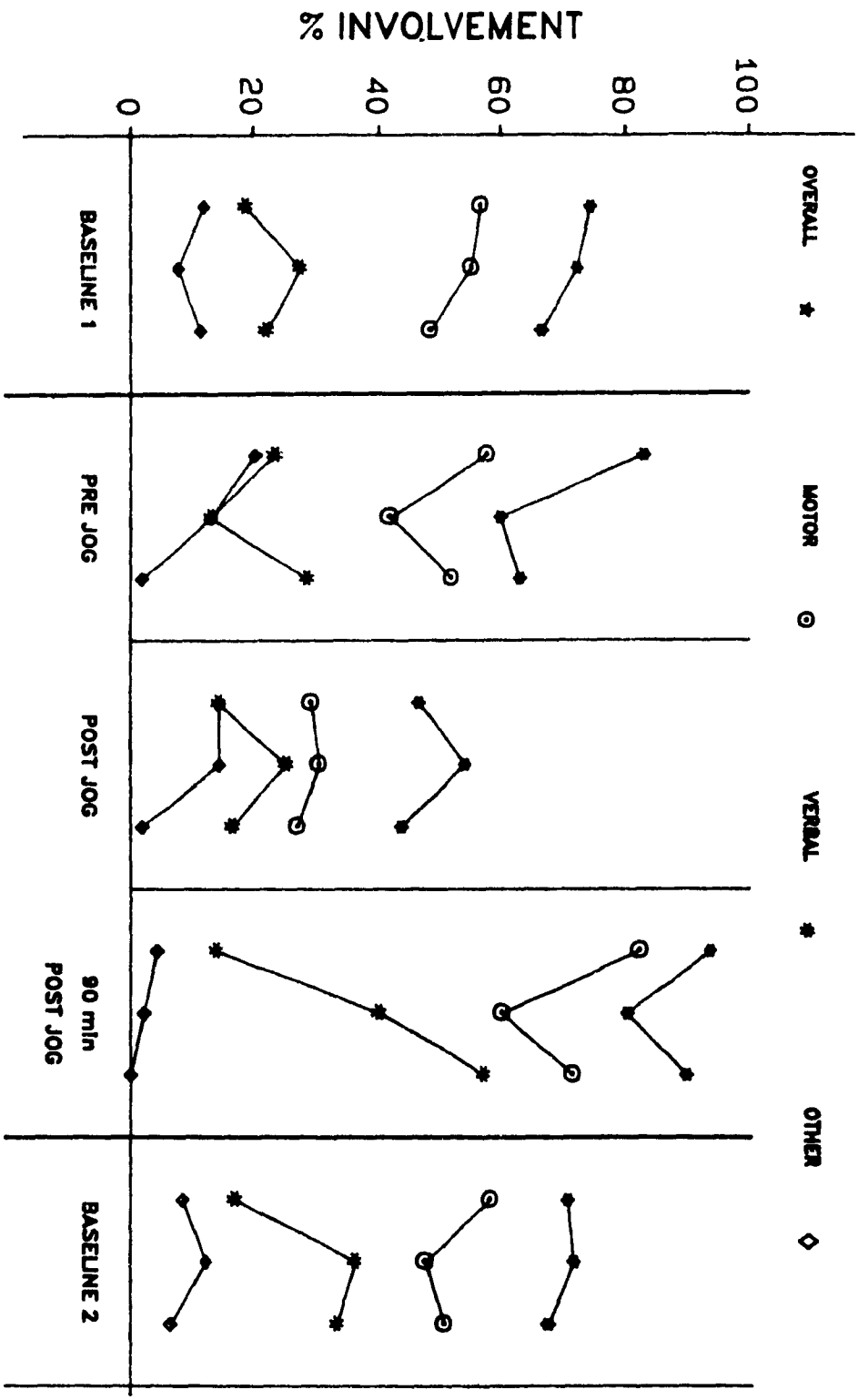

Figure 10: Components Involved in Stereotypic Behaviours for Subject 3 - Jogging Condition

This trend has been shown in previous research (Harris & Wolchik, 1979; Rollings et al., 1977) where the suppression of one type of stereotypic behaviour, in this case motor, results in the emergence of another type of stereotypic behaviour (verbal).

It is important to note that following each jogging session, increases occurred in subject two's level of verbal stereotypic behaviours, while correspondingly decreases were noted in the motor component. Thus it can be concluded that subject two was differentially affected by the vigorous exercise treatment.

The vigorous exercise treatment resulted in decreases in all three subjects' level of motor stereotypic behaviours. With regard to the verbal component, subject one's level decreased, subject two's increased, and subject three's level remained constant. Thus only subject two was differentially affected by the jogging treatment.

4.4 Perceptions of Treatment Effectiveness: Response from Shadows

The shadows were given a questionnaire to evaluate their subject's behaviour at the end of each session. The questionnaire attempted to evaluate interest, mood, state of relaxation, level of self-stimulation, motivation, and level of fatigue (see Appendix E and F).

Tables 3, 4, and 5 outline the shadows' answers after each session. Each question pertained to the behaviour of the subjects immediately following the walking or jogging treatment, as compared

to the subjects' typical behaviours. Question 1 was concerned with the interest and attention level of the subject, question 2 with the subject's mood, question 3 with the subject state of relaxation, question 4 asked if the subject was involved in self-stimulatory behaviours, question 5 was interested in the subject motivational level, and question 6 queried if the subject was tired. The shadow's were asked to respond to each question with one of five answers: 1= not at all; 2= slightly less than usual; 3= same as usual; 4= more than usual, 5= very noticeable change.

It was hypothesized that if changes in stereotypic behaviour were occurring as a result of the intervention, such changes would be reflected in a broader range of the subjects' behaviours such as mood, interest and attention level, and motivation level. Furthermore, they should be noticed by the shadows if there were important changes. The questionnaires were also viewed as an important way to explain unexpected results. For example, on a given session, a subject may be particularly bothered by something unrelated to the experimental treatment, and any special intervention would not be effective in reducing stereotypic behaviours. This ineffectiveness of the treatment should be reflected not only in the occurrences of stereotypic behaviours but as well in the shadow's responses on the questionnaire for that given day.

Table 3: Shadow's Report on Subject 1

QUESTIONS**

	Interest	Mood	Relaxation	Self Stimulation	Motivation	Fatigue
	1	2	3	4	5	6
baseline 1	2.0	2.0	2.0	2.3	2.3	2.0
walking	3.4	3.4	2.8	2.8	3.2	1.4
jogging	1.8	2.0	2.3	3.0	2.0	2.3
baseline 2	2.5	2.8	2.8	2.5	2.8	1.5

SCALE
1 = not at all
2 = slightly less than usual
3 = same as usual
4 = more than usual
5 = very noticeable change

mean across sessions
**see page 102 for full description of questions

Table 4: Shadow's Report on Subject 2

QUESTIONS**

	Interest	Mood	Relaxation	Self Stimulation	Motivation	Fatigue
	1	2	3	4	5	6
baseline 1	3.0	3.0	3.0	2.7	3.7	2.7
walking	3.0	2.8	3.0	3.2	3.6	2.8
jogging	2.8	2.8	3.0	2.8	2.8	2.8
baseline 2	3.0	3.5	3.5	3.0	3.0	2.8

SCALE
1 = not at all
2 = slightly less than usual
3 = same as usual
4 = more than usual
5 = very noticeable change

mean across sessions
**see page 102 for full description of questions

Table 5: Shadow's Report on Subject 3

QUESTIONS**

	Interest	Mood	Relaxation	Self Stimulation	Motivation	Fatigue
	1	2	3	4	5	6
baseline 1	3.3	3.3	2.7	3.3	3.0	2.7
walking	3.2	3.2	2.6	2.8	3.2	2.0
jogging	3.0	3.0	3.3	2.7	3.0	3.3
baseline 2	3.0	2.7	3.3	2.3	2.7	2.7

SCALE
1 = not at all
2 = slightly less than usual
3 = same as usual
4 = more than usual
5 = very noticeable change

mean across sessions
**see page 102 for full description of questions

The shadows' perceptions of the effectiveness of the moderate exercise program on the stereotypic behaviours of the subjects are found in Tables 3, 4, and 5. Increases, albeit slight were noted in interest, attention (2.0 to 3.4), and motivation (2.3 to 3.2) for subject one (Table 3). While the motivational level for subject two increased, interest and attention levels remained the same. These results can be viewed in a positive manner as they reflect modest increases in appropriate behaviours following exercise.

It was hypothesized that the effects of the jogging would decrease the subject's level of stereotypic behaviours and it was hoped that other behaviours such as attention and motivational levels would be positively influenced as well. Previous research has shown that jogging did not affect the level of correct responding in an answering task (Watters & Watters 1980), but did increase appropriate play and academic responding (Kern et al., 1982; Reid et al., 1988)

The jogging did not appear to have an effect on subject one (see Table 3). The shadow noted that the subject was not interested nor motivated in tasks presented. While the subject's level of self-stimulation decreased 19.3% following jogging, this observation was not noted by the shadow who reported the subject to self-stimulate the same as usual. Fatigue was not reported by this subject's shadow. Previous research has discounted the effects of fatigue (Kern et al., 1982; Reid et al., 1988).

Subject two's level of interest in instruction, mood and motivation level was not influence by the vigorous exercise treatment. Similar to subject one, fatigue was not noted by the subject's shadow. The response by the shadows were viewed as an important way to explain unexpected results. For example, on the second jogging session subject two was extremely bothered and the treatment proved to be ineffective. This state of extreme agitation was not only reflected in the subject's level of self-stimulatory behaviour, which increased to 87.5% following jogging, (see Figure 3) but also in the shadow's report. For that session the shadow reported that subject two was in a bad mood, not interested at all in tasks presented, very agitated, and only slightly motivated.

Table 5 represents the effects of jogging on subject three's behaviour. This subject's interest, mood, and motivation remained unchanged following jogging. It was however noted that the subject was slightly more relaxed than normal. The shadow reported a slight decrease in stereotypic behaviour on the part of subject three, even though this subject had the greatest mean decrease in stereotypic behaviours (20.9%) following the jogging treatment.

While each subjects' level of stereotypic behaviours decreased following the vigorous exercise treatment, the shadows' responses did not reflect these decreases. This discrepancy does not fault the quantitative data collection method utilized but rather brings into question concerns about the clarity of the questionnaire, or

the ability of the shadows to record these behaviourial decreases. It is unlikely that the clarity of the questionnaire could be responsible as every effort was made to ensure that questions were clear, direct, and easily understood. In order to guard against responder bias, the shadows were blind to the purpose of the study. Perhaps, due to the fact that no instructions were given on how to answer the questionnaire, the shadows answers were based on the subjects' behaviour all day as opposed to only following the exercise treatment.

In conclusion, all three subject's level of attention, interest, and motivation did not suffer as a result of the experimental intervention, and in some cases positive behaviourial changes resulted as a function of the treatment.

4.5 Duration of Treatment Effects

It was hypothesized that decreases in self-stimulatory behaviours would be noted immediately following physical exercise, but that these effects would dissipate with time. With the exception of two studies, the research done concerning physical exercise and the reduction of self-stimulatory behaviours has not examined the duration of treatment effects. Allen (1980) attempted to determine the optimum effectiveness of three jogging treatments (no jogging, five minutes of jogging, and 10 minutes of jogging). The author also analyzed stereotypic behaviours on an hourly basis. Results indicated that the least number of disruptive behaviours

occurred immediately following the 10 minutes of jogging. Allen (1980) remarked that since the fewest disruptive behaviours occurred immediately following exercise, activities such as reading should be scheduled as they required more attention.

Bachman and Fuqua (1983) analyzed the duration of treatment effects immediately following exercise, one hour following exercise, and two hours following exercise. Each observational time period was 15 minutes. While the data was not consistent over all four subjects, the lowest level of self-stimulatory behaviours generally occurred in the first observational period, immediately following exercise.

To evaluate the duration of the treatment effects, the subjects were filmed immediately following exercise (post treatment and one and a half hours later (90 min. post treatment). The overall frequency of stereotypic behaviours for each subject pre treatment, post treatment and 90 min. post treatment are found in Tables 6 and 7.

Table 6: Overall Frequency of Stereotypic Behaviours across Sessions for Moderate Exercise Treatment

Subject	Pre Walk	Immediate Post Walk	90 min postwalk
1	73.0%	77.3%	87.5%
2	77.1%	81.4%	92.0%
3	70.2%	66.4%	87.5%

Table 7: Overall Frequency of Stereotypic Behaviours across Sessions for Vigorous Exercise Treatment

Subject	Pre Jog	Immediate Post Jog	90 min post jog
1	75.0%	55.7%	88.8%
2	72.0%	59.8%	73.0%
3	69.0%	48.1%	86/5%

Table 6 outlines the overall frequency of stereotypic behaviours for the pre walk, immediate post walk and 90 minutes or (1 1\2 hours) post walking sessions for all three subjects. Subject 1's pre walk level of stereotypic behaviour was 73%. Following treatment, this increased 4.3% to 77.3%. A further increase of 10.2% was noted for the 90 min. post walking session. Subject 2 followed a pattern similar to subject 1. Following treatment, an increase of 4.3% in frequency of self-stimulation was noted, and a further increase of 10.6% was found in the 90 min. post walking session. Slightly different results are noted for subject 3. As previously noted, this subject's stereotypic behaviours decreased 3.6% following walking, only to increase 21.1% in the 90 min. post walking session to a level of 87.5%. Graphic analysis of these observations are found in Figures 2, 3, and 4. From these figures one can see that the frequency of stereotypic behaviours noted in the 90 min post walking, or after lunch session was consistently high for all three subjects.

Table 7 outlines the overall frequency of stereotypic behaviours for all three subjects for the jogging condition. The level of subject one's pre jog stereotypic behaviour was 75%. Following the jogging treatment a decrease of 19.3% was noted in the frequency of self-stimulatory behaviours. In the 90 min. post jogging session the frequency of stereotypic behaviours was 88.8%, an increase of 33.1%. A graphical analysis of these observations can be found in Figure 2. With the exception of one slightly lower

score of 70%, all frequencies found in the 90 min. post jogging session for subject one were above 90%

Subject two's level of pre jog stereotypic behaviours was 72%. Following jogging this decreased 12.2% to 59.8%. In the 90 min. post jogging session the frequency in which subject two engaged in self-stimulatory behaviours increased 13.2%, returning to a level of 73%. These results represent overall frequencies. From Figure 3 one notes that subject two's behaviour was extremely variable. For the first two jogging sessions, high levels of self-stimulatory behaviours were noted for pre-jog (80.4% & 80.8%), immediate post-jog (62.5% & 87.5%), and 90 min. post jog sessions (84.4% & 85%). However, for the final two sessions, lower levels of stereotypic behaviours were found in the pre jog (66.1% & 61.8%), and immediate post jog sessions (48.2% & 44%). Correspondingly, the levels of self-stimulatory behaviours found in the 90 min. post jogging session were lower as well (70.6% & 35%). It is interesting to note that the final two jogging sessions occurred after subject two started taken medication to control obsessive behaviours. While the effects of the medication are not evident in the final baseline measure where subject two's level of stereotypic behaviour increased once again, it is possible that the combination of the medication and vigorous exercise had a calming influence on this subject, and explains the decreases in self-stimulatory behaviours noted.

Subject three's pre jogging level of stereotypic behaviours was 69%. Following jogging this decreased considerably to a post jog level of 48.1%, only to increase to 86.5% in the 90 min. post jog or after lunch session. This sharp increase of 38.4% is represented graphically in Figure 4. From Figure 4 it can be remarked that subject three had consistently high levels of self-stimulatory behaviours (92.9%, 80%, & 89.3%) in the after lunch jogging session,.

An overall representation of the effect of the treatments for all three subjects can be found in Figure 1. From this graph it can be observed that for all three subjects the highest levels of stereotypic behaviours are found in both after lunch sessions. These results corroborate the previous research of Allen (1980) and Bachman and Fuqua (1983). Both studies noted that decreases in stereotypic or inappropriate behaviours occurred immediately following exercise but increases in stereotypic behaviours were evident in the second hour following treatment

4.6 Statistical Significance of the Effects of the Treatments

It was hypothesized that significant decreases would occur following the jogging sessions. To evaluate if significant changes occurred between the two treatments, a multivariate analysis of variance was performed. The multivariate tests of analysis for the effects of treatment indicated significant differences ($P < .002$) between the walking and jogging treatments (see Appendix G). A

univariate analysis of variance evaluated the effects of the two treatments (Appendix H). They were compared on the pretest, post test and 90 min post test. No significant differences were found between the walking pretest and the jogging pretest. The same nonsignificant results were found for the 90 min post tests. However, significant differences ($P < .001$) were found between the walking post test and the jogging post test, thus reaffirming the hypothesis that in order to achieve decreases in the stereotypic behaviour of individuals with autism, the exercise must be vigorous.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was to examine the influence of different intensities of exercise on the stereotypic behaviours of autistic individuals and the duration of these effects. This chapter contains the summary and conclusions of the investigation and is divided into the following sections: (5.1) Summary of the Methodology, (5.2) Summary of the Findings, (5.3) Conclusions, (5.4) Implications and (5.5) Recommendations for Further Study.

5.1 Summary of the Methodology

The subjects in this study were two eleven year old male students with autism and one eleven year old female student with autism. All three subjects attended a school designed specifically for the autistic learner and were diagnosed independently as autistic based on the criteria outlined in the DSM III and by the stereotypic behaviour patterns exhibited by each subject.

The study consisted of three phases: (1) a first observational period where the subject's level of stereotypic behaviours were determined; (2) administration of experimental conditions involved the implementation of a moderate and vigorous exercise program; and (3) a second observational period (return to baseline conditions).

The experimental condition consisted of two exercise programs which were implemented each once a week to all three subjects. The moderate exercise program consisted of 15 minutes of walking, while the vigorous exercise program consisted of 15 minutes of jogging. The two programs were differentiated on the basis of intensity measured by heart rate and by the distance covered during the fifteen minutes.

Each experimental session consisted of three parts: (1) a 45 minute pre-exercise observation period to establish each subject's level of stereotypic behaviour on that day; (2) a 45 minute post-exercise observation period to measure the effects of the exercise program on each subject's level of stereotypic behaviour; and (3) a 30 minute final observational period occurring 90 minutes after the implementation of the exercise program in order to establish the duration of effects on each subject's level of stereotypic behaviour.

Following each treatment session, the shadows were given a questionnaire which evaluated their subject's interest, mood, state of relaxation, level of self-stimulation, motivation and fatigue.

A interval-sampling procedure similar to previous research (Kern et al., 1982; 1984) was used where each subject was videotaped. The order of taping was randomly selected for each session, but once the order was established, it was maintained throughout the entire session. Each minute was divided into four 15 second intervals. The presence of stereotypic behaviours was

recorded on precoded data sheets on which the observer indicated if the subject was involved in a motor, verbal or other stereotypic behaviour.

The data in this investigation was analyzed by two methods: 1) visual analysis of graphs was employed to determine the effects of the exercise programs on stereotypic behaviours, and 2) a multivariate analysis of variance was used to determine the statistical significance of the effects.

5.2 Summary of the Findings

Reliability was determined by means of an inter-rater agreement score. The primary observer viewed all sixteen sessions while a secondary observer viewed four sessions. The average percent agreement was 85%. In addition, the secondary observer viewed another tape to determine the reliability of the differentiation of stereotypic behaviours into motor, verbal and other. In this instance, the percent agreement was 75%.

The moderate exercise program was found to be ineffective in reducing stereotypic behaviours. For two of the subjects, increased levels of stereotypic behaviours were noted following the walking condition. The three components of stereotypic behaviours, motor, verbal and other were not differentially affected by the walking condition. The shadow's perceptions on the effectiveness of moderate exercise were that modest increases in appropriate behaviours resulted as a function of the walking condition.

Following the vigorous exercise program decreases in stereotypic behaviours were noted in all three subjects. The mean reduction between pre jogging and post jogging sessions was 17.5% (12.2%-20.9%). Of the three components of stereotypic behaviours the one which consistently decreased following jogging was the motor component. The shadow's responses concerning the effectiveness of the vigorous exercise program on appropriate behaviours indicated that the subject's level of attention, interest and motivation did not suffer as a result of the jogging treatment. As well some positive behaviourial changes were noted.

The vigorous exercise treatment was most effective in reducing stereotypic behaviours immediately after implementation. One and an half hours following the jogging treatment, the duration of the treatment effects were no longer evident as the subject's level of stereotypic behaviours had returned to their pre-exercise frequency.

The multivariate analysis of variance indicated that no significant differences occurred between the two pretests and the two 90 min post tests. However, significant differences were noted ($P < .001$) between the walking post test and the jogging post test supporting the hypothesis that vigorous levels of exercise are needed to bring about reductions in the stereotypic behaviours of individuals with autism

5.3 Conclusions

Based on the findings and within the limitations and delimitations of the present study, the following conclusions are made:

1. If exercise is to be used to as a method to decrease stereotypic behaviours in individuals with autism, the intensity of the exercise program must be vigorous.

2. The duration of the effects of a physical exercise program on the stereotypic behaviours of autistic individuals are evident immediately following exercise, but dissipate with time.

5.4 Implications

A number of implications appear warranted from the present investigation. The results indicate that vigorous exercise can effectively be used to decrease stereotypic behaviours in individuals with autism. Subjects demonstrated significant decreases in their level of stereotypic behaviours following the jogging condition. This response to the exercise program supports future research in the area of exercise and stereotypic behaviours. Thus vigorous exercise can be viewed as a practical and successful method of reducing the frequency of stereotypic behaviours in individuals with autism.

The categorization of the stereotypic behaviours into three components allowed for the observation of any differential effects on the three components as a function of the two exercise programs. Both programs involved similar movement patterns but differed in intensity. The motor component of stereotypic behaviours consistently decreased following the vigorous exercise condition. Consequently, a useful means available to practitioners for decreasing motor stereotypic behaviours is vigorous exercise.

The effects of the vigorous exercise on stereotypic behaviours were apparent only immediately following jogging. These decreases lasted approximately 45 minutes and were followed by a return to a pre-exercise level of stereotypic behaviours. The implications of these findings to curriculum programming are that activities which require sitting still should be scheduled immediately after a vigorous exercise session. As well another implication is the feasibility of interspersing exercise breaks throughout the day as a method of decreasing stereotypic behaviours.

5.5 Recommendations for Further Study

Based on the results of the present study, the following are recommended as avenues of further study:

1. The effects of other exercises on the stereotypic behaviours of autistic individuals should be examined. Specifically exercises that closely resemble the modality in which the autistic individual receives sensory stimulation should be used.

2. The present study used low functioning subjects with high levels of stereotypic behaviours. The effects of exercise need to be examined on subjects who are higher functioning and who exhibit more complex forms of stereotypic behaviours.

3. The duration of the effects of various types of exercise need to be examined. Previous research has shown that the effect of exercise on stereotypic behaviours are immediate and short term, lasting approximately 45 -60 minutes (Allen, 1980, Bachman & Fuqua, 1983). Perhaps some exercises have longer lasting effects.

4. The effects of interspersing exercise throughout the day need to be examined as a viable method of reducing stereotypic behaviours.

5. If exercise is to be used on a daily basis, the optimum time of day to implement such a program needs to be researched.

6. If interspersing exercise throughout the day proves to be a useful method, the amount and effectiveness of the vigorous exercise given during each episode needs to be examined. For example, is it more effective to implement a 10 minute exercise program three times a day or a five minute exercise break six times a day.

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APPENDIX A

Subject One's Stereotypic Behaviours

MOTOR
flapping of hands
body rocking
stereotypic finger flexing
mouthing or biting hands
twisting ears or pressing hands
running away

VERBAL
spontaneous loud vocalizations - guttural
giggling/laughing
clucking

OTHER
mouthing objects
pulling hair
intense staring for longer than 3 sec
gazing at hands 6" near eye
saliva fingering
rotation of eyes

APPENDIX B

Subject Two's Stereotypic Behaviours

MOTOR
head or body shaking
jerking of body
stereotypic finger flexing
mouthing or biting hands
rubbing fingers on hands
tensing of body
jabbing, poking
running around room
tearing paper/books

VERBAL
screaming
delayed echolia, repetition of command several times
repetition of words out of context
giggling/laughing

OTHER
intense staring for longer than 3 sec
saliva fingering

APPENDIX C

Subject Three's Stereotypic Behaviours

MOTOR
flapping of hands
head or body shaking
jerking of body
body rocking
mouthing or biting hands
tapping fingers against things
hitting
tensing of body

VERBAL
screaming
spontaneous loud vocalizations - guttural
giggling/laughing
snorts

OTHER
spinning objects
intense staring for longer than 3 sec
rotation of eyes
playing with objects

APPENDIX D
Data Recording Sheet

15 minute block

date:_____
subject:_____

MINUTES\INTERVALS

	1st			2nd			3rd			4th		
	M	V	O	M	V	O	M	V	O	M	V	O
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												

TOTAL ___\60

APPENDIX E

Questionnaire English Version

Using the scale below, please answer the following questions.

SCALE
1 = not at all
2 = slightly less than usual
3 = same as usual
4 = more than usual
5 = very noticeable change

question 1: I found my subject to be attentive to and interested in the instructions given _____.

question 2: I found my subject to be in a good mood_____.

question 3: I found my subject to be relaxed _____.

question 4: I found my subject to stimulate _____.

question 5: I found my subject to be motivated _____.

question 6: I found my subject to be tired _____.

APPENDIX F

Questionnaire French Version

Si vous plait utilizer l'échelle ci desous et répondez aux questions suivantes.

L'ECHELLE
1 = pas du tous
2 = un peux
3 = comme toujours
4 = plus que d'habitude
5 = changement notable

question 1: J'ai trouvé que mon sujet était attentif et interessé à performer les instructions donner ___.

question 2: J'ai trouvé que mon sujet était de bonne humeure_____.

question 3: J'ai trouvé que mon sujet était calme_____.

question 4: J'ai trouvé que mon sujet se stimule _____.

question 5: J'ai trouvé que mon sujet était motivé_____.

question 6: J'ai trouvé que mon sujet était fatigué_____

APPENDIX G

Multivariate Analysis of Variance

Effects of Treatments (Walking and Jogging)

Multivariate Tests of Significance

Test Name	Value	Exact F	Hypoth. DF	Error DF	Signif of F.
PILLAIS	.50547	6.81402	3.00	20.00	.002
HOTELLINGS	1.02210	6.81402	3.00	20.00	.002
WILKS	.49453	6.81402	3.00	20.00	.002

APPENDIX H

Univariate Analysis of Variance

Effect of Treatments (Walking and Jogging)
Univariate F-Tests with (1,22) DF

Variable	Sum of Squares	Mean Square	F Ratio	F Prob.
PRETEST	.7004	.7004	.0071	.933
POSTTEST	2499.0004	2499.0004	19.1497	.001
90 min. POSTTEST	435.2017	435.2107	2.6411	.118