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Burkhart, Jennifer Ellen

EVALUATION OF TEN SECOND CONTINGENT OVERCORRECTION AND VISUAL SCREENING PROCEDURES IN COMBINATION WITH DRI FOR REDUCING STEREOTYPIC RESPONDING AND INCREASING ADAPTIVE BEHAVIOR IN MENTALLY RETARDED CHILDREN

The Ohio State University

Ph.D. 1987

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To My Father
Who inspired me to achieve this goal
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I. Introduction

The term stereotypy has been used in many contexts which has resulted in some confusion in the literature. In addition to its use as a descriptor of developmentally normal, adaptive, and species specific motor movements (Berkson, 1983), the word "stereotypy" has been used to describe atypical behaviors seen in clinical populations (Baumeister & Forehand, 1973).

The so-called "pathological" stereotyped behaviors have been defined as "repetitious, topographically invariant motor behaviors" (Baumeister & Forehand, 1973), "mechanical postures or movements" (Ollendick & Matson, 1978) "rigid mechanical motor acts" (Berkson & Davenport, 1962), and "repetitious, functionally maladaptive, topographically invariant motor sequences for which the reinforcing consequences are unknown" (Baumeister & Forehand, 1973). Pathological stereotypies have also been called "blindisms" or "autisms" in reference to their association with certain diagnostic labels, (Berkson, 1983). However, the most comprehensive and clinically relevant definition of abnormal stereotyped acts was provided by Berkson (1983) who suggested that a "useful" definition involve reference to (a) unresponsiveness or invariability of such behavioral patterns relative to environmental change, (b) a long term standing (i.e., months) duration in the behavior
repertoire, (c) inappropriateness of the behavior relative to developmental level, and (d) of a voluntary and generally repetitive nature.

A distinction between stereotypies and tics should be made here although this differentiation is somewhat vague. According to Stedman's Medical Dictionary (1982) stereotypy refers to constant repetition of certain meaningless gestures or movements whereas tic refers to involuntary repeated contraction of a certain group of associated muscles or a habitual spasmodic movement of any part. Attempts at defining stereotypies has been further confused with terms such as "self-stimulation" and "self-injury" which have been used interchangeably to describe the same behaviors (Baumeister & Forehand, 1973; Carr, 1977; Corbett, 1975; Denny, 1980; Kissel & Whitman, 1977; Luiselli, Pemberton, Helfen, 1978; Lemke, 1974). Although the definition of stereotypy is global enough to include reference to both self-stimulatory and self-injurious behaviors, a distinction appears useful since it is not clear whether these behavioral classes share a common basis. The term self-stimulation refers to motivational factors whereas self-injury refers to the consequences of the behavior. Self-stimulation is defined as "stereotypic non-self-abusive behavior that has no apparent effect upon the environment" (Foxx & Azrin, 1972) whereas self-injury is defined as
"stereotyped behaviors in which the individual inflicts damage to the body" (Tate & Baroff, 1966) either immediately or over the course of time (AABT Task Force, 1982).

Stereotypic behaviors characterized by both self-stimulatory and self-injurious behaviors include body rocking, hand waving, head weaving (Berkson, 1967; Kaufman & Levitt, 1965), mouthing and rubbing of body parts (Berkson & Mason, 1964; Hollis, 1965; Hutt and Hutt, 1965; Kaufman, 1967; Lovaas, Litrownick, & Mann, 1971). Inappropriate vocalizations, (including humming, laughing, screaming, finger flicking, hand tapping hand/arm flapping, hand clapping, pacing, and body twirling or spinning (Lovaas, Litrownick, & Mann, 1971). Further examples include teeth grinding (i.e., bruxism), self-fondling and masturbation, hand wringing (Lovaas, 1982), head banging (Bucher & Lovaas, 1968; Schroeder, Schroeder, Smith, & Daldorf, 1978; Schroeder, Mulick & Rojahn, 1980), eye gouging/poking, hair pulling, self-biting, self-scratching (Favell, McGimsey, & Jones, 1978; Schroeder, et al., 1978; 1980), and other forms of self-hitting. Rectal digging, self slapping (Tate & Baroff, 1966), self-pinching, pica, self-punching, elbow pounding, rumination (AABT Task Force, 1982), pill rolling, limb posturing, and digit sucking (Forehand & Baumeister, 1978) are also cited as examples of these
behaviors.

Because few longitudinal studies have been reported, questions remain as to whether pathological stereotyped behaviors are residuals from an earlier developmental period or whether there is a qualitative difference. It has been suggested that such behaviors are not discontinuous along a continuum of adaptiveness, deviance, severity, and frequency (Baumeister & Forehand, 1973; Baumeister & Rollings, 1976) since they are exhibited by normal infants (Thelen, 1979) and adults (Barash, 1974; Evans, 1978) as well as mentally retarded, autistic, psychotic and blind individuals. On the other hand, Berkson (1983) suggested that a distinction be made between the variable, repetitive motor movements and object manipulations exhibited by infants and the invariant, rhythmical stereotypic acts characteristic of clinical populations.

Statement of the Problem

Although repetitive motor movements are considered typical of normal infants, at some point in development such behaviors are considered excessive, abnormal, and maladaptive (Baumeister & Forehand, 1973). Such behaviors in the normal pediatric population rarely result in chronic problems, but the frequency, prevalence, and persistent nature of stereotypic behaviors in clinical populations has been the focus of
much attention by theorists and researchers (Kaufman & Levitt, 1965). Results from the available research indicate that such pathological behaviors compete with stimuli used as consequences for desirable behavior (Frankel, Freeman, Ritvo, Chikamp & Carr, 1976). In addition to serving no apparent functional or adaptive purpose (Baumeister & Forehand, 1973; Hutt, Hutt, Lee & Ounstead, 1972; Koegel, Firestone, Kramme & Dunlap, 1974; Lovaas, 1967), stereotypies are also noted to interfere with attention and learning (Koegel & Covert, 1972; Risley, 1968), prosocial behavior (Lovaas & Newsome, 1976), appropriate object directed behavior (Favell, 1973; Horner & Barton 1980), and language (Zegiob, Jenkens, Beeker & Bristow, 1976). Moreover, such behaviors are associated with reduced interaction with the environment (Berkson & Mason, 1964; Koegel & Covert, 1972; Lovaas, Litrownick & Mann, 1971; Risley, 1968) can socially stigmatize an individual (Epstein, Doke, Sajway, Sorrell & Rimmer, 1974), and in their most severe forms cause physical harm (Bachman, 1972; Baumeister & Forehand, 1973; Smolev, 1971).

Importance of the Problem and Limitations

From a developmental/evolutionary perspective, the study of stereotypic behaviors should address three important questions: (a) What are the etiologic mechanisms (i.e., where do they originate)?, (b) How do
they develop (i.e., how does an individual grow to respond in such a manner)?, and (c) What is the function of such behaviors (i.e., how are they maintained)? (Tinbergen, 1951).


The behavioral approach is predicated on years of research which has revealed that the strength of a behavior is influenced by its consequences (AABT Task Force 1982). Behavioral treatment procedures operate on reorganizing the consequences for a behavior (e.g., punishing or removing positive reinforcement for inappropriate behavior, reinforcing appropriate
behavior), or reorganizing antecedents which differentially affect the occurrence of a behavior.

Although these treatment procedures have generally been found effective, some are more successful than others. According to the available literature, some of these procedures are only partially successful, produce only temporary effects, do not readily generalize and are associated with behavioral side effects (Baumeister & Forehand, 1973; AABT Task Force, 1982). In addition, the methodological limitations of many of these studies have yielded inconsistent and confusing results which have made interpretations of intervention effectiveness very difficult for the practitioner (see Johnson & Baumeister, 1978; Schroeder, Schauell, & Elmore, 1983). Based upon these findings, there exists a critical need to develop a well defined study which evaluates the effectiveness of behavioral treatment procedures for their clinical relevance in suppressing stereotypic acts while enhancing adaptive behaviors.

**Purpose of the Study**

The purpose of the present study was to go beyond the questions of origin, development, and maintenance to address treatment effectiveness in order to identify relevant factors in successfully treating such behaviors when they do occur. In this study several behavioral treatment procedures including positive reinforcement in
the form of differential reinforcement of incompatible behaviors (DRI) and punishment in the form of visual screening and overcorrection were assessed to evaluate their effectiveness in reducing stereotypic behaviors. Some clinicians have suggested that, because the predominence of stereotypic acts in the behavioral repertoire of an individual limits positive interaction with the environment, interferes with adaptive functioning and poses a major obstacle to education and training, elimination of such behaviors may be necessary prior to successful acquisition of appropriate behaviors (Barton, Repp, 1981).

Several studies have assessed DRI alone (Baumeister & Forehand, 1971; Brawley, Harris, Allen, Fleming & Peterson 1969; compared its effectiveness to other procedures (Cavalier & Ferretti, 1980; Denny, 1980), or assessed the effectiveness of DRI in combination with other procedures (Azrin, Kaplan & Foxx, 1973; Richmond & Bell, 1983). None of the reviewed research to date have looked at the strategic application of a DRI component in the time sequence of a behavioral treatment package.

While DRI represents a positive reinforcement technique, to strengthen appropriate (adaptive) behaviors, visual (sensory) screening and overcorrection represent punishment techniques to reduce stereotypic responding. The rationales for comparing these two
punishment procedures are that (a) overcorrection has proven effective for treating a wide range of stereotyped acts (Forehand & Baumeister, 1974; AABT Task Force, 1982) whereas visual screening represents a more novel procedure which only recently has been proven effective in reducing stereotypic behaviors (see review by Singh, 1981), (b) visual screening appears to be a fairly simple procedure which can be easily implemented whereas overcorrection is a lengthy procedure involving several steps, (c) both represent fairly unintrusive punishment procedures in comparison to such procedures as aversive electrical shock (Horner & Barton, 1980; Singh, 1981), water mist, bitter substance, and aromatic ammonia (Baumeister & Baumeister, 1978), (d) the differential effectiveness of these two procedures has not been assessed in any of the intervention research to date, and (e) although positive practice overcorrection alone is believed to enhance adaptive behaviors (Foxx & Azrin, 1973; Ollendick & Matson, 1978), this has not been confirmed by the available research (Ollendick, Shapiro, & Barrett, 1981; Shapiro et. al., 1980).

**Research Questions**

The following empirical questions were addressed in this research:

1. Which of two punishment procedures (e.g., visual screening or Positive Practice Overcorrection) was more
effective in treating stereotypic behaviors, both self-injury and self-stimulation?

2. Was there a difference in the responsiveness of the two classes of stereotypic behaviors (e.g., self-injury, self-stimulation) to these two punishment procedures, either alone or in combination with DRI?

3. Did the introduction of a DRI technique in combination with visual screening or overcorrection enhance the effectiveness of one punishment technique over the other in terms of suppressing stereotypic behavior and increasing appropriate behavior?

4. Would the introduction of DRI following behavioral suppression result in more rapid and dramatic increases in adaptive responding in comparison to the simultaneous implementation of DRI in combination with the punishment procedures or DRI alone?

5. What was the effect if any of visual screening and overcorrection on negative collateral behaviors (e.g., aggression, disruption)?

6. Would the effectiveness of either of the procedures generalize spontaneously beyond the treatment session or would they have to be programmed?

7. Would treatment affects be maintained over time (i.e., 6 weeks follow-up)?
II. Review of the Literature

Because stereotypic behaviors are so prevalent among the clinical population, they have come under considerable study. Generally, research on these behaviors has focused upon four major areas; (a) prevalence of stereotypies among the normal and clinical populations, (b) theories on the origin and maintenance of stereotypies, (c) environmental correlates of stereotypies, and (d) interventions designed to reduce rates of stereotypic behaviors.

Prevalence

Several studies have addressed the prevalence of stereotypic behaviors in various populations including normal children, institutionalized retarded individuals and other clinical groups such as schizophrenic, abused, neglected, and psychiatric patients.

Individual Characteristics

Although the available research on the prevalence of stereotypy and its relationship to individual characteristics is inconsistent and sketchy, some general conclusions have been drawn. According to their review of 50 response categories in 60 studies using behavioral treatment to control stereotypic behaviors in handicapped individuals, LaGrow and Repp (1984) reported that the most prevalent stereotypies included body rocking, mouthing, and complex hand/finger movements. Considerable
inter-individual variability is evidenced in the severity, rate, duration, topography, and tenacity of stereotypic behaviors (Baumeister & Rollings, 1976). Some individuals display a variety of these behaviors (Baumeister & Forehand, 1973; Delissovoy, 1961; Levison, 1970) but others may exhibit only one form (Adams, Tallon, & Stangle, 1980; Schroeder, Mulick & Rojahn, 1980). Adams, Tallon, and Stangle (1980) reported that at least one type of stereotypic behavior was exhibited by the majority of institutionalized residents. Research results suggest a direct relationship between stereotypy and level of functioning with the greater incidence (MacKay, McDonald, & Morrisey, 1974; Maisto, Baumeister, & Maisto, 1978; Van Velzen, 1975), frequency, and duration in lower IQ groups (Berkson & Davenport, 1962; Baumeister & Rollings, 1976; Ross, 1972). Such behaviors have been found to be of longstanding duration (up to 30 years) in many subjects described in the literature (Azrin, Gottlieb, Hughart, Wesolowski & Rahn, 1975), with a mean history of 15.7 years at least for self-injury (Matin & Rundle, 1980).

**Sex Differences**

Although studies generally do not report sex differences in relation to stereotypic responding, some have reported findings, albeit conflicting, on sex differences in relation to self-injury. For instance,
DeLissovoy (1961) and Phillips and Muzaffer (1961) reported self-injury to be twice as common in males than females, whereas other researchers have reported a 3:1 male:female ratio (Kravitz, Rosenthal, Teplitz, Murphy, & Lesser, 1960; Levy & Patrick, 1928; Sallustro & Atwell, 1978). Several studies have reported a greater incidence of self-injury among females than males with rates ranging from 10.5% to 64.7% in females and 5.7% to 35.5% in males (Phillips & Muzaffar, 1961; Green, 1967; Maisto, et al., 1978; Soule & O'Brian, 1974). Sex differences reported also include greater incidence of more multiple forms of self-injury in females but greater severity in males (Maesto et. al., 1978).

**Prevalence Among the Normal and Clinical Populations**

Although prevalence rates vary across studies, it has been estimated that 10-20% of the typical pediatric population exhibits stereotypic acts primarily in the form of body rocking, body swaying, and head banging at some time in development (DeLissovoy, 1962; Lourie, 1949; Shentoub & Soulairic, 1967; Kravitz, Rosenthal, Teplitz, Murphy, & Lesser, 1960). Singh (1981) reported the occurrence of self-injury in the typical pediatric population to vary between 3.3% and 20% or 5.3% and 37% depending upon the population studied.

Developmental trends on the prevalence of self-injury among the normal pediatric population have been
reported by a number of investigators. Generally these reports indicate that the occurrence of self-injury is 11-17\% for normal infants age 9-11 months (Shentoub & Soulairic, 1961), and 9\% (Shentoub & Soulairic, 1961) to 15.2\% (DeLissovoy, 1962) for infants 19-32 months of age. Age of onset is consistently reported to be at approximately 8 months (DeLissovoy, 1962; Kravitz, et al., 1960) with the average duration being about 17 months (Kravitz, et al., 1960). Age of termination has been reported to be between 3 (DeLissovoy, 1962) and 5 (Shentoub & Soulairic, 1961) years of age.

One of the most extensive developmental studies on the production of stereotypic behaviors in infancy was carried out by Kravitz and Boehm (1971) who found that among normal infants, 10\% exhibited head rolling and 7\% displayed head banging at a median age of 12 months whereas retarded subjects were found to be delayed in all of these behaviors except head rolling and head banging. The prevalence of stereotypy in mentally retarded children has been estimated to be between 8 and 14\% (Baumeister & Rollings, 1976) and among the psychiatric population at approximately 4-5\% (Frankel & Simmons, 1976; Phillips & Muzaffer, 1961). The greater frequency of stereotypic behaviors among blind than sighted retarded individuals has been found by several investigators (Berkson & Davenport, 1962; Guess, 1966).
The frequent occurrence of these behaviors in this population has led some to coin the term "blindisms" as a descriptor of stereotypic acts. However, this appears to be a misnomer since such behaviors exhibited by blind children are not discernible from the stereotypies evidenced by sighted children (Warren, 1977). Fraiberg (1977) suggested that the persistent rocking behavior in blind infants in comparison to normals evidenced just prior to crawling is due to the lack of visual motivation to move. Berkson and Karrer (1968) have provided evidence from nonhuman primate research, that blindness, in and of itself, is not the causative factor for such behaviors.

Although less attention is focused in the area, deaf individuals also exhibit stereotypic acts. For example, in a sample of 320 deaf children residing in a dormitory of a residential school, Bachara and Phelen (1980) found the incidence of nocturnal body rocking to be 17% in subjects aged 5-9 years, 12% in children aged 10-13 years, and 10% in children aged 13-16 years. Of these subjects 80% of the children who exhibited body rocking were referred for psychological services due to social or emotional difficulties in comparison to 18% of the nonrockers.
Prevalence Among Institutionalized Individuals

Although a cause-effect relationship has not been determined, the prevalence of stereotypy is much higher among the institutionalized population (Baumeister & Forehand, 1973; Berkson & Davenport, 1962; Foxx & Azrin, 1972; Kaufman & Levitt, 1965; Murphy, Nunes, Hutchings & Ruprecht, 1977), particularly those carrying a psychiatric diagnosis (Baumeister & Rolling, 1976).

Prevalence reports have estimated stereotypy to be as high as 40% in the institutionalized psychiatric population (Green, 1967; Shodell & Reiter, 1968) with 50-90% of these individuals reportedly exhibiting such behaviors in childhood (Green, 1967). The prevalence of stereotypy among the institutionalized autistic and mentally retarded population has been estimated to be as high as 65-66% (Berkson & Davenport, 1962; Kaufman & Levitt, 1965; Ollendick & Matson, 1978).

Some direct evidence suggesting that incidence, intensity, and variety of stereotyped movements is associated with institutionalization was provided by Kaufman (1967) who found that the institutionalized subjects displayed more stereotypies than their home counterparts who were on a waiting list for institutionalization (Kaufman, 1967). Stereotypic behaviors have been reported to occur 7-47% of observed time in institutionalized individuals (Repp and Barton, 1980) and
13% of observed time in community-based severely retarded individuals (Repp, Barton & Gottlieb, 1983). Barton and Repp (1981), in assessing the distribution of stereotypic responding among the institutionalized mentally retarded, multiply-handicapped population found a 34% prevalence among those with physical handicaps, 39% among those with hearing impairments, 43% among those with visual impairments and 44% among those with visual impairments.

In an attempt to distinguish among different stereotypies, Kaufman and Levitt (1965) found an incidence of 69% occurrence of body rocking, 63% occurrence of head rolling and 57% occurrence of hand waving in 83 moderately to profoundly retarded institutionalized individuals. Tierney, Fraser, McGuire and Walton (1981), in their survey of all mental deficiency hospitals in Scotland, found an overall prevalence of 33% with the most common behaviors being body rocking (15%), complex finger movements (12%) and various self-injurious behaviors such as head hitting/banging, and self-biting/scratching (12%). Self-injury alone among the institutionalized mentally retarded population has been estimated to occur widely between 5 and 37 percent (Forehand & Baumeister, 1976; MacKay, McDonald & Morrissey, 1974; Maisto, Baumeister & Meisto, 1978; Singh, 1981) although the majority of researchers report a 9% prevalence of self-injury in this population (Schroeder, 1974).
Theories of Stereotypic Behaviors

The importance of formulating a theory of stereotyped behavior is that it gives the researcher a construct for exploration and testing from which relevant evidence is selected. Numerous explanations have been provided for the origin and maintenance of stereotypic behaviors. These theories generally fall within several broad categories differing upon the degree of stress placed upon environmental, behavioral, or biological factors. The theoretical orientation of those studying stereotypic behaviors are broadly subsumed within developmental, psychodynamic, learning, homeostatic, neural oscillation, organic and chemical induction categories (Baumeister & Forehand, 1973; Baumeister & Rollings, 1976; Carr, 1977).

Developmental Theory

The developmental sequence and timing of stereotypies are important components of the developmental theory of stereotypic behaviors. Many repetitive motor movements which are considered abnormal stereotypies when exhibited in older individuals are evidenced in the behavioral repertoire of normal infants. This has lead researchers to hypothesize that stereotypic behaviors are normal motor patterns of infancy and childhood which have remained in the primitive behavioral repertoire of abnormal individuals (Gessell & Amatruda, 1941; Lourie, 1949).
The basis of the developmental theory is that these behaviors, in addition to reflecting normal developmental stages and maturational processes, serve adaptive functions. Much support for this view is provided through research with institutionalized individuals and reports on the normal pediatric population. For example, Sallustro and Atwell (1978) found that normal infants who exhibit body rocking and head banging attained several motor milestones earlier than infants who did not generally engage in such behaviors suggesting that stereotypies may promote motor and cognitive development by enhancing neural pathways. Lourie (1949) concluded that such behaviors may be normal activities which accelerate motor and personality development. Because in the majority of cases such behaviors are transitory, generally persisting over a short period of time, other researchers (Thelen, 1981; Wolff, 1968) have considered repetitive patterns of infancy to be innate "substrates" of more complex motor behaviors and suggest that if such behaviors do not meet their goal of promoting motor and cognitive development, they remain in the behavioral repertoire affording some likeness to the stimulatory functions provided by typical interaction with the environment (Berkson, 1983; Thelen, 1981). Data from both cognitive (Inhelder, 1968) and motor (Fraiberg, 1977) research lend support to this interpretation.
Developmental views on the etiology and maintenance of stereotypic behaviors differ according to the theoretical orientation of the researchers. For example, Gessel (1954) viewed rocking to be a stage in the progression of prone development. Piaget (1952) viewed kicking and waving as secondary circular reactions, a scheme within the sensorimotor stage of development.

The developmental profile of stereotypic behaviors was probably best outlined in a series of studies by Thelen (1979, 1981b). Through a longitudinal study of 20 normal infants 1 month to 1 year of age, Thelen (1979) observed 47 dissimilar stereotypies over the course of a year. Nearly half of the sample exhibited 50% of these behaviors whereas all subjects displayed at least 17% of these stereotypies. Frequencies in rates of these behaviors was noted to peak according to the topography of the motor response with an overall peak period at 6-7 months and decline over the last few weeks of the first year of life.

The emergence of peak periods of topographically similar rhythmical motor movements led Thelen (1979) to conclude that such behaviors represent "transient" behaviors between uncoordinated activity and more complex coordinated, voluntary motor control. Rates of kicking movements peaked just prior to the onset of crawling and rhythmical hand and arm movements occurred immediately
prior to the development of complex manual skills (Thelen, 1981b). Similarly, rhythmic movement was associated with development of sitting and emerged following development of smooth, well established voluntary coordination (Thelen, 1981b).

**Motor Development.** The theory that stereotypies span the gap between immature motor behaviors and full voluntary coordination lends support to the possibility that persistent stereotypies in abnormal infants is due to developmental delays resulting in both later and slower onset of integrated behavior. Support for this view is provided through studies with abnormal infants (Field, Ting & Shuman, 1979; Fraiberg, 1977; Kravitz & Boehm, 1971; Wolff, 1967). In research with Down Syndrome infants, Wolff (1967) found that the appearance of stereotyped behaviors paralleled the sequence of motor development in normal infants. Kravitz and Boehm (1971) found that the onset of these developmental sequences was extremely delayed to the extent that by the end of the first year only one of 22 Down Syndrome infants initiated stereotypies evidenced by normal infants. Perhaps of greater significance is the research of Field, Ting and Shuman (1971) which showed that postmature infants demonstrated earlier onset of rhythmic movements while premature infants evidenced significantly later onset.
Once dates were corrected for gestational ages in the premature infants, no differences were found leading the authors to conclude that maturation was the important factor in determining onset schedule of rhythmic movements (Field, et. al., 1979).

Congenitally blind infants, on the other hand, have been found to show an uneven progression in motor development. Fraiberg (1977) found that, although blind infants developed postural milestones in the form of independent sitting, "bridging" on hands and knees, and standing at normative ages, locomotor development was notably delayed. In addition, both normal and blind infants were found to rock in sitting, hands and knees, and standing positions, but this behavior was prolonged in blind infants (Fraiberg, 1977).

**Cognitive Development.** A similar sequence on the developmental nature of stereotypy was proposed by Piaget (1952) and Wallon (1973) who considered such rhythmic motor movements to reflect early stages of cognitive development. "Circular reactions" in infancy were thought to be derived from an innate tendency for repetition, the aim of which was to provide information to the infant about the nature of his/her body and at later stages about the world. Piaget's studies (1952) on normal developmental progression throughout the first year of life, indicate that to the extent that the child persists
in self-manipulation he/she fails to develop adaptive environmental manipulation which is crucial to understanding the world. These studies are consistent with the view that, although stereotypies may be originally manifested as rigid, programmed responses to a variety of stimuli, they eventually serve an adaptive cognitive function (Piaget, 1952).

Evidence from the cognitive developmental literature suggests that abnormal children become "fixated" at levels of primary and secondary circular reactions, behaviors characterized by repetitive body movements directed toward the self (i.e., primary) and the environment (i.e., secondary) (Inhelder, 1968). Inhelder (1968) defined this fixation as not only "slower" development but also "deceleration" and "termination" of progress in the latter part of a developmental period when continued cognitive growth is expected. Delayed mental functioning among the retarded was described as showing a viscosity characterized by both retarded growth and traces of old patterns which should have been discarded for new coordinations (Inhelder, 1968).

Generally the bulk of research in the cognitive area suggests that fixation occurs from some form of disruption in the normal sequence of development either through inadequate learning experience, lack of appropriate stimuli, lack of critical role models or
physical and cognitive delays, views not inconsistent with other theories of stereotypic behaviors (see Learning, Homeostatic, Organic Theories).

**Arousal and Adaptive Functioning.** Within the developmental research, stereotypies have been found to be released by generalized arousal shifts triggered by external stimulation or internal states. However, as structures mature and adaptive needs become altered, the "relevance" or "potency" of this stimuli for eliciting such behaviors changes (Thelen, 1981a). For example, Thelen (1981b) found at 6 months of age, infants used rhythmical kicking in response to both the presence of the mother (greeting/excitement) and following removal of a toy (protest/frustration). However, at 12 months of age, within the same contexts, the infants used more mature voluntary, coordinated movements such as crawling or walking to the mother (Thelen, 1981b).

"Releasing stimuli" were identified by parents for about 84% of these behaviors in infants during the first year of life. Eliciting situations generally fell within the context of: interactions with the caregiver, interaction with others, interest in or play with objects, feeding situations, kinesthetic changes, and non-alert states (Thelen, 1979). In addition, there appeared to be a clear developmental trend in the strength of certain contexts for eliciting stereotypy
with interaction with caregiver emerging as a strong elicitor at 3-5 months and object-related stereotypy more potent in the later part of the first year (Thelen, 1981a).

**Psychodynamic Theory**

A number of hypotheses regarding the motivation and maintenance of stereotypic behaviors are subsumed under the psychodynamic theory. Although there are several possible interpretations for stereotypy within this framework, the basic premise is that such behaviors are symbolic expressions of "guilt," regression," poor "ego identity," displacement," and "hysteria" (Crabtree, 1967; Fitzherbert, 1950; Frederick & Resnick, 1971; Freud, 1954; Greenacre, 1954; Stinnett & Hollander, 1970).

Some researchers in this area have suggested that stereotypic behaviors are attempts to establish body reality (Greenacre, 1954) or outline ego boundaries (Bychowski, 1954) in individuals who have difficulty distinguishing the self from the external environment (Hartman, Kris, & Loewenstein, 1949; Zuk, 1960). Others have proposed that stereotypic (primarily self-injurious) behaviors are attempts by individuals to alleviate guilt (Beres, 1952; Frankl, 1963) or as representations of self-preservation expressed as a victory of the life instinct over the death instinct (Arons, 1981), or
conversely as expressions of the death instinct itself (see review by Cain, 1961).

**Auto-aggression.** Some psychodynamic theorists view self-injury as primitive behavioral manifestations of aggression turned inward, channeled by the superego, and following arousal of guilt (Cain, 1961). Hoffer (1950), in addressing self-biting as an autoaggressive behavior in infancy, suggested that this behavior is restricted to defective and possibly psychotic children. Others have also noted the relationship of self-biting to neurotic and psychotic individuals (Hendrick, 1950).

**Auto-Eroticism/Maternal Deprivation.** Some psychodynamic theorists view stereotypic behavior as autoerotic activity (Kris, 1954; Lester, 1972; Levy & Patrick, 1928) or as an attempt to establish relations with an aloof or vascillating mother (Brody & Axelrod, 1970; Spitz, 1965 & Spitz & Wolf, 1949).

The fairly high incidence of self-injury among children placed and reared in unstimulating institutional environments have been interpreted as evidence that self-injury occurs as a result of disruption of normal mother-child interactions (Bender & Yarnel, 1941; Ribble, 1943; Spitz, 1946) and as an expression of the death instinct (Ferenczi, 1955). For example, self-injury is seen as a symbolic attack upon the mother due to abandonment (Bender & Yarnell, 1941) or expression of depression,
anxiety, or frustration due to the absence of the mother (Spitz, 1946; 1953; Ribbel, 1943). Spitz and Wolf (1949) suggested that maternally deprived infants engage in self-injury due to anaclitic depression which turns aggression and libidinal drive inward. Silberstein, Blackman, and Mandell (1966) proposed that self-injury was a substitute for incomplete maternal stimulation.

**Learning Theory**

The learning theory of stereotypic behaviors emphasizes conditions of positive reinforcement or negative reinforcement. The origin and maintenance of stereotypic behaviors are considered to be determined by the interrelationship between the environment, the stereotypic acts, and the consequences of such acts. Stereotypy is considered an instrumental or learned operant response maintained by stimuli either delivered or removed contingently or noncontingently upon its elicitation (Carr, Newsom & Binkoff, 1976) rather than as a reflexive movement. Within this theory there are essentially two distinguishable approaches; the positive reinforcement or discriminative stimulus hypothesis (Bachman, 1972; Skinner, 1953), and the negative reinforcement or avoidance hypothesis (Skinner, 1953).

**Positive Reinforcement Hypothesis.** The premise of the positive reinforcement (discriminative stimulus) hypothesis is that stereotypic acts are maintained by
positive reinforcement which is delivered upon performance of these behaviors (Lovaas, Freitag, Gold, & Kassorla, 1965; Lovaas & Simmons, 1969) and that stereotypy should decrease when the social contingencies which supposedly maintain them are withdrawn.

An important aspect of the positive reinforcement hypothesis is evidence that stereotypies can be brought under strong stimulus control (Baumeister & Forehand, 1972; Hollis, 1968; Mulhern & Baumeister, 1969). Support for this hypothesis is derived from studies showing that contingent social attention increases rates of self-injury whereas attention withdrawal reduces or suppresses self-injurious behaviors (Bucher & Lovaas, 1968; Frankel & Simmons, 1976). The stimulus control property of stereotypic behaviors has been demonstrated in a number of studies on humans (Ayllon & Azrin, 1966) and animals (Holtz & Azrin, 1961; Sandler, 1962).

In one of the first systematic studies of self-injurious behavior, Lovaas, Freitag, Gold, and Kassorla (1965) found that withdrawal of adult attention for performance of singing and dancing in a child resulted in high rates of stereotypic responding. Similarly, in a two phase experiment where attention was not provided following instances of self-injury, such behaviors substantially decreased relative to baseline conditions, whereas in the second phase, where attention was
delivered contingent upon each incidence of self-injury, these behaviors increased above the baseline level suggesting a functional relationship between the occurrence of self-injury and presentation of specific social events (Lovaas et al., 1965). Lovaas and his colleagues (Lovaas et al., 1965; Lovaas & Simmons, 1969) also found that self-injurious behaviors increased dramatically when comforting remarks or preferred activities were made contingent upon this behavior.

In his initial discussion of the discriminative function of stereotypic behaviors, Skinner (1953) suggested that an apparently aversive behavior such as self-injury could serve as conditioned positive reinforcement if such behavior was selectively associated with a stimulus which was reinforcing and that maintenance of such behaviors would be expected to continue over long periods through intermittent schedules of reinforcement. Other researchers in this area have since supported this view by proposing that stereotypies are superstitious behaviors maintained by positive reinforcement (Spradlin & Girardeau, 1966), irregular reinforcement (Baumeister & Forehand, 1971), or gross imbalance between reinforcement for self-directed versus outward directed behaviors (Azrin, Kaplin, & Foxx, 1973). The speculation underlying these observations is that the probability of stereotypic behaviors will increase if
positive reinforcing stimuli occurs at the time such behaviors are being evidenced. As the rate and frequency of stereotypic behaviors increases, there is an analogous increase in the probability that reinforcing stimuli will occur in the presence of these behaviors strengthening them further (Hollis, 1971a). A substantial amount of literature exists which suggests that removal of social consequences (Ferster, 1961; Hamilton, Stephens, & Allen, 1967; Wolf, Risley & Mees, 1964) or isolating an individual (Jones, Simmons, & Frankel, 1974; Lovaas & Simmons, 1969) reduces self-injurious behaviors. Several studies have shown that rates of self-injurious behavior may be fairly low when a child is alone but much higher in the presence of adults (Bucher & Lovaas, 1968; Romanczyk & Goren, 1975).

Negative Reinforcement Hypothesis. The negative reinforcement (escape/avoidance) hypothesis holds that stereotypic behavior is maintained through the termination, escape, or avoidance of an aversive stimulus (Carr, Newsome, & Binkoff, 1976). The available research in this area focuses upon the role of escape motivation in the development and maintenance of stereotypies. According to this view, stimuli that are associated with aversive consequences develop conditioned aversive properties and continued exposure to these conditioned events may become as aversive as the initial aversive stimulus.
Therefore, continued exposure to the aversive stimulus is decreased by self-injurious responding if such behaviors result in escape or avoidance (Skinner, 1953).

More recent studies have cited demand-related situations as being associated with self-injury (Jones et. al., 1974; Myers & Deibert, 1971; Edelson, Taubman, & Lovaas, 1983; Wolf, Risley, Johnston, Harris & Allen, 1967), the hypothesis being that demands may lead to an escape /avoidance response in the form of self-injury which is maintained by the termination of the aversive stimuli. For example, Carr, (1977) found that rates of self-injury were higher in a classroom setting, in comparison to free play situation. In further support of this view, Carr, Newsome, & Binkoff (1976) found higher rates of self-injury following demanding comments in an 8-year-old schizophrenic boy who exhibited these behaviors in both demand and nondemand situations. Other researchers (Edelsen, et. al., 1983) have reported a substantial increase in self-injurious behavior following presentation of verbal demands, denials, and reprimands.

There are a number of anecdotal reports available regarding the relationship between self-injurious behaviors and avoidance of an aversive situation (Bucher & Lovaas, 1968; Green, 1968; Tate, 1972). For example, Tate (1972) reported fright and other "emotional" responses in association with self-injury in a young
female subject following removal of restraints. Carr (1977) suggested that restraints may, over time, represent "safety signals" whereas removal of the restraints may communicate that demands (e.g., for bathing, dressing, etc.) may be placed upon the individual. Similarly, Smith, Chethik, and Adelson (1969) suggested that stereotypies are regressive behaviors representative of a former "safe" activity which occurred during frustration or excessive demand-related situations. Silverman, Watanabe, Marshall and Baer (1984) argued that self-injury may be a negative reinforcer and that resistance to restraint release is maintained by avoidance of self-injury.

In direct contrast to the negative reinforcement hypothesis, many researchers (Bucher & Lovaas, 1968; Corte, Wolf, & Locke, 1971; Favell, McGimsey & Jones, 1978; Favell, McGimsey, Jones & Cannon, 1981; Foxx & Dufrense, 1984; Lovaas & Simmons, 1969; Peterson & Peterson, 1968; Tate, 1972; Tate & Baroff, 1966; Thomas & Howard, 1971; Yeakel, Salisbury, Greer, & Marcus, 1970) have cited increases in stereotypic responding following removal of physical restraints as evidence that these devices served as positive reinforcers and that a child learns over time to get a reinforcer reinstated (i.e., being restrained again) by emitting self-injurious behaviors. These arguments point to the partial overlap
in the avoidance and discriminative hypotheses. This circularity is evident in the sense that once cues associated with an aversive situation become conditioned stimuli capable of eliciting escape of avoidance behaviors (such as self-injury), these behaviors would then be reinforced by the escape or avoidance from aversive situations which follow.

Other investigations have shown what has been called the "vicious circle" effect (Baumeister & Rollings, 1976), that punishment of escape and avoidance responses is capable of maintaining stereotypic behaviors (Bender, 1969; Brown, Martin & Morrow, 1964; Corte, et. al., 1971; Rollings & Melvin, 1970; Sandler & Davidson, 1971). For instance, Sandler and Davidson (1971) found that subjects with long histories of avoidance-training would continue to exhibit an avoidance response which was previously learned even when the response was later punished with electric shock and even though a nonpunished alternative response was available. White and Taylor (1967) observed instances of self-injury in the form of arm biting during implementation of shock procedures to decrease rumination in a female retarded child. Corte, Wolf, and Locke (1971) also reported that markedly increased rates of self-injury were associated with the implementation of mild shock contingent upon the self-injury exhibited by a female retarded subject. Similarly, Rollings,
Baumeister, and Baumeister (1977) found that use of over-correction procedures to repress stereotypic rocking was associated with increased self-hitting early in treatment whereas self-injurious behavior decreased along with stereotypy through continued treatment suggesting that extinction occurred within the training environment and self-injury which may have been associated with escape or avoidance in the past was ineffective in preventing escape from the punishing effect of overcorrection in the training environment.

Homeostatic Theory

Within the homeostatic theory, stereotypic responses are considered self-stimulatory or arousal reducing behaviors, the premise being that a certain level of stimulation is optimal for the organism and individuals will engage in compensatory behaviors when this homeostatic condition is altered. Most of the formulations within the homeostatic theory share a common focus on organismic variables with stereotypic behaviors viewed as reflexive movements controlled within the central nervous system or sensory system of the organism. The individual is seen as automatically adjusting his/her level of stimulation relative to changes in overall environmental stimuli. Thus, the issues of origin and maintenance of stereotypes within the homeostatic model
involve the distinction or relative emphasis between environmental factors and intrinsic organismic variables.

**Self-Stimulation.** The self-stimulatory hypothesis holds that a certain degree of stimulation from the tactile, vestibular, and kinesthetic modalities is necessary for the organism and when this (distal) stimulation is at an insufficient level, the organism will engage in (proximal) stereotypic acts to produce the necessary stimulation (Baumeister & Forehand, 1973; Cleland & Clark, 1966; DeLissavoy, 1964; Green, 1967; 1968; Kulka, Fry, & Goldstein, 1960; Lourie, 1949; Lovaas, 1967; Province & Lipton, 1962; Rutter, 1966; Silberstein, Blackman & Mandell, 1966). Many researchers have proposed that stereotypic acts serve self-stimulatory functions because of the high degree of monotony that generally characterizes the environment of individuals who exhibit them. Dennis and Najarian (1957) coined the term "stimulation hunger" in describing self-injurious behaviors in a group of institutionalized orphans left to lie in their cribs due to understaffing. Similarly, Lovaas, Litrownick, and Mann (1971) suggested that mentally retarded individuals engage in stereotypy due to the sensory input which it provides to those who have no functional means of responding to the environment. Others have argued that mentally defective
individuals are insensitive to normal levels of environmental stimulation (Cataldo & Haris, 1982; Metz, 1967; Rimland, 1964) and therefore need more sensory stimulation than normal individuals (Berkson & Mason, 1964) in the form of intense self-stimulation in order to provide enough tactile input to obtain sensory arousal (Edelson, 1983).

Several investigators within this area have considered stereotypies to be the result of either restraint or monotony (Berkson & Davenport, 1962; Davenport & Menzel, 1963; Rulka, et. al., 1960; Levy, 1944; Lourie, 1959; Mason & Green, 1962) whereas others have attributed them to extreme changes in emotionality and arousal due to confinement (Evans, 1978) or isolation-rearing (Berkson & Mason, 1964; Berkson, 1967; Fox, 1966; Fuller, 1967). The isolation-rearing studies of Harlow and his associates (Cross & Harlow, 1965; Harlow & Griffin, 1965; Harlow & Harlow, 1962; 1971) have been cited as support for the self-stimulatory hypothesis, the typical finding being that many partially isolated monkeys and those having a long history of social and sensory isolation (Gluck & Sackett, 1974) engage in stereotypic behaviors, whereas monkeys reared with their mothers and peers do not.

In support of this hypothesis, Levy (1944) noted a reduction in self-injurious behaviors among
institutionalized orphans who were restricted to their cribs following presentation of toys, presumably due to the increased tactile and kinesthetic stimulation provided. Similarly, Collins (1965) attributed the elimination of self-injury in a retarded adult to the increased tactile and kinesthetic stimulation provided by toys, activity, and a radio.

A related theoretical construct is that of vestibular stimulation which is based upon the concept of neurological development. Specifically, investigators in this area have stressed sequential dendritic elaboration (Purpura, 1974) and the association between semicircular canal stimulation and maturation of synaptic conductivity in the cerebellum (Kreutzberg, 1976). Indirect evidence for this hypothesis is provided through the positive correlation found between stereotypic behavior in severely and profoundly mentally retarded children and crib confinement which is believed to reduce vestibular stimulation (Warren & Burns, 1970). Further support is provided through the developmental literature which suggests that the amount of stereotypy evidenced by infants is inversely related to the amount of vestibular stimulation provided through caregivers (Thelen, 1979; 1980). Vestibular stimulation through spinning, rocking, or other forms of body movement has been found to reduce stereotyped movements (MacLean & Baumeister, 1981a).
**Arousal Reduction/Filtering.** Similar to normal infants, stereotypies in abnormal individuals appear to be expressions of arousal states. Arousal, stress, and frustration have been inferred in both the situation induction as well as the pathogenesis of stereotypies in both humans and animals (Lewis & Baumeister, 1983).

Several researchers in this area have suggested that pathological stereotypies are related to increased central and peripheral nervous system activation and constitute coping responses which serve to reduce excessive levels of arousal or stress (Hutt & Hutt, 1970; Kinsbourne, 1980; Stone, 1964). Others maintain that such behaviors are expressions of tension, discomfort, or unsatisfied needs (Brody, 1960; Gerard, 1957; Ilg & Ames, 1955; Kaufman & Levitt, 1965; Klaber & Butterfield, 1968) and are instrumental in releasing or relieving tension and anxiety (Lourie, 1949; Mahler, 1945). These views are supported by a number of experimental studies which implicate an arousal reducing or filtering effect from repetitive, rhythmic stimulation (Hutt & Hutt, 1965; Oswald, 1960; Van Den Daele, 1970, 1971). For example, Hutt and Hutt (1970) found increased rates of stereotypic behaviors in autistic children during situations which apparently increased arousal level such as in the contexts of novel stimulus or social encounter. These behaviors were attributed to high levels of nonspecific
activity in the ascending reticular system, the function of which was to prevent arousal from reaching a critical level (Hutt & Hutt, 1965). Similarly, Brett and Levine (1979) demonstrated that schedule-induced polydipsia suppresses the activity in the pituitary-adrenal axis, a system which is well known for its activation under stressful situations (Mason, 1968). Schedule-induced behaviors in the form of polydipsia and pacing have been reported in schizophrenic patients on several (fixed interval) schedules (Kachanoff, LeVeille, McLellend & Wayner, 1973). Schedule-induced locomotion has also been observed in normal adults and mentally retarded adolescents (Muller, Crow, & Chesney, 1979).

In a different vein, Stone (1964) suggested that stereotypies may function as attempts to cope with stressful activity by creating a sequence of intense rhythmic sensory stimulation which produces a lowered state of consciousness similar to sleep. A series of experiments by Baumeister and Forehand (Baumeister & Forehand, 1971; Forehand & Baumeister, 1970; Baumeister & Forehand, 1972) revealed that interference of goal-directed behavior also increased rates of stereotypic responding.

**Neural Oscillator Theory**

The premise of the neural oscillator theory is that stereotyped behaviors are maintained through a system of
central motor control by intrinsic neural oscillators. This is an alternative to the view that such behaviors are maintained by sensory input from the movements themselves. The rhythmical nature of stereotypies plays a major role in this theory in that the expression of motor behaviors is believed to be based upon the possible association between intrinsic biorhythms (e.g., those involved in heart rate, respiration [Jammes & Rosenberger, 1971], locomotion and grooming [Fentress, 1973; Wolff, 1968]) and neural oscillators which regulate the expression of an active motor system in the absence of external stimulation (Berkson, 1983). According to the neural oscillator theory, interruption of feedback should have little effect upon stereotyped behavior, whereas the self-stimulatory hypothesis would predict that either prevention of the feedback or provision of stimulation equivalent to the feedback would stop the behavior.

Few quantitative studies have attempted to investigate or describe the rhythmical nature of stereotypic behaviors (Maris, 1971) or to relate these behaviors to other periodic rhythmical phenomena such as physiological oscillations (Jammes and Rosenberger, 1971; Wolff, 1968). Nevertheless, several lines of research, including neurophysiological animal studies, lend support to the premise that pathological stereotypies are fairly
stable yet high rate biobehavioral rhythms that are modulated by a central control system of neural pacemakers (Pohl, 1977; Ritvo, Ornitz, & LaFranchi, 1968; Wolff, 1968).

Neurophysiological Research. Data from neurophysiological studies suggest that high levels of repetitive motor activity can block or dampen sensory input and that, once triggered, such action patterns run their course to completion without further environmental influence (Barlow, 1977). Early support for the independence of neural oscillators from sensory feedback was demonstrated by Von Holst (1954) through evidence that the deafferented central nervous system was capable of generating stable high rate rhythmic activity in the absence of sensory feedback. More recently, following review of two years of biological research based upon data generated from isolation, deafferation, and paralysis studies on the central nervous system, Delcomyn (1980) reported that patterns of rhythmic behavior are maintained despite prevention or hindrance from potential sources of sensory feedback.

Following a comprehensive review of the literature, Bentley and Konishi (1978) also concluded that the general feature of possibly all rhythmical activity is central pattern generation. On the other hand, Stein
(1978) reported that the frequency and amplitude of motor output can be influenced by sensory feedback, suggesting that although sensory feedback may not control such behaviors, it may play a role in modifying them.

Wollf (1967) was among the first to advance the notion that stereotypies occur as a result of high frequency biological rhythms on the basis of his observation that nonpurposeful sucking in infants showed a consistent temporal organization in terms of interburst duration, peak periods, and mean rate of sucks per burst both between and within subjects. Following further observation of similar rates of stereotypic rocking in normal infants, clinical groups, and reappearance of such behaviors in neurologically impaired individuals, Wollf (1967), 1968) proposed that the high frequency rhythmicities typical of infancy were expressions of neurological "timing mechanisms" which comprised the "necessary but not sufficient" basis for later coordinated movements. Other researchers (Lewis, MacLean, Johnson, & Baumeister, 1981; Romanczyk, Gordon, Crimmins, Wenzel, & Kistner, 1980; Ritvo, et. al., 1968; Thelen, 1979) have since concluded that stereotypic behaviors may be under strong central neural oscillator control. Wolff & Simmons (1967), who studied normal full-term infants under three different conditions (e.g., regular sleep, regular sleep with pacifier, and regular
sleep with nonnutritive sucking) found that subjects were least responsive to tactile stimulation during episodes of nonnutritive sucking. Similarly, Lewis and Baumeister, (1973), in studying orienting response to auditory stimulus in mentally retarded children, found that subjects showed less responsiveness (as measured by cardiac activity) when engaged in stereotypic body rocking. Lovaas, Litrownick, and Mann (1971) found a significant increase in latency towards approaching a candy dispenser in autistic children during episodes of stereotypic responding.

Temporal Pattern of Stereotypies. A few investigations have examined the possibility that the temporal pattern of stereotypies may reflect periodic variation. At least two temporal aspects of repetitive behaviors have been recognized; intra-bout intervals and inter-bout intervals. Although the available data tends to support the consistency of intra-bout intervals, the distribution of inter-bout intervals has not been thoroughly investigated. Current research has typically reported ultradian rhythms or periodic fluctuations in stereotypies that have a less than 24 hour cycle, although circannual, lunar, and circadian rhythms have also been noted (Romanczyk, et. al., 1980; Francezon, Visier, & Mennesson, 1981). Lewis, MacLean, Johnson & Baumeister (1981) found fairly clear evidence of
ultradian rhythms in profoundly retarded institutionalized subjects who were observed over 8-14 hour periods across several days. Romanczyk and colleagues (Romanczyk, et al., 1980) found ultradian fluctuation in stereotypic behaviors of a 5-year-old psychotic girl with neurological impairment. Such behaviors are generally reported to cycle within 90 and 120 minute intervals (Meier-Koll, Fels, Koffer, Schulz-Weber, & Thiessen, 1977; Sorosky, Ornitz, Brown, Ritvo, 1968; Tierney, et al., 1981; although cycles up to 4 hours have also been reported (Lewis, et al., 1981).

Hierarchical Organization. Wolf's original speculations on stereotypies receives support from more recent work based upon the concept of hierarchical organization of motor control (Bernstein, 1967; Bruner, 1970; Connolly, 1977; Dawkins, 1976; Easton, 1972; Elliot & Connolly, 1974; Evarts, Bizzi, Burke, DeLong, & Thach, 1971; Gallistel, 1980; Turvey, 1977). According to this hypothesis, the highest centers of movement control do not directly regulate individual muscles but instead function as "executive" commands which induce, coordinate and refine interactions between progressively lower order centers of control.

The current ethological explanation that infant stereotypies are the source of timing mechanisms in gross motor development (Thelen, 1981) is consistent with this
concept of hierarchical motor organization. Timing is seen as a crucial component in the process of coordinated motor development (Connolly, 1977; Thelen, 1981). This timing concept is useful in explaining the striking analogies between situations which promote release of stereotypies in normal infants and those in clinical groups since stereotypic behaviors appear to be the function of both heightened and attenuated sensory stimulation in both groups (Berkson & Mason, 1963; Davenport & Berkson, 1963; Frankel, Freeman, Ritvo, & Pardo, 1978; Kaufman & Levitt, 1965; Klaber & Butterfield, 1968; Stroufe, Streicher, & Stutzer, 1973; Thelen, 1978, 1981a). Fentress (1976a; 1976b) suggested that extreme levels of stimuli determine the change from interactive, goal-directed, extrinsically controlled behaviors to intrinsically controlled stereotypies. Interactive behavior is seen as requiring more neural capacity than preprogrammed motor movements and the predominance of stereotypic behaviors within the clinical population may result from reduced neural processing capacity due to pathological conditions whereas, in normal infants, this capacity may be limited due to cortical immaturity across the first year of life. As the normal infant develops and the processing capacity matures, the child responds with voluntary, adaptive movements unless stereotypic responding is prolonged by
such factors as abnormal neuromotor development and extreme environmental deviation (Bowlby, 1969) which delay maturation of integrated motor behaviors (see Developmental Theory). In both normal infants and clinical groups, activation or arousal may strain existing neural capacity and a shift from peripheral/interactive control to central/self-organized control in the form of stereotypies which are neurologically available at their developmental level are the likely response (Fentress, 1976a, 1976b; Thelen, 1981).

**Organic Theory**

The organic theory of stereotypies suggests that such behaviors are the products of aberrant physiological processes. The available data implicates either genetically based aberrations such as Lesch Nyhan (Lesch & Nyhan, 1964) syndrome or nongenetic aberrations involving the vestibular system (Chee, Kreutzburg & Chase, 1978; Clark, Kreutzburg & Chee, 1977; Kantner, Clark, Allen & Chase, 1976). Anatomical factors such as central nervous system (CNS) Lesions (Jones & Barraclough, 1978) and both genetic (e.g., Riley-Day Syndrome) and nongenetic (e.g., otitis media) aberrations involving elevation in the pain threshold are also subsumed within this theory.
**Disease Models.** Self-injurious behaviors are a predominant characteristic of Lesch Nyhan syndrome, a rare sex-linked genetic disorder occurring only in males as a result of enzyme (Hypozanthine quinine phosphoriboyl transferase) deficiency which is necessary for the metabolism of the chemical purine. In addition to the prevalence of self-injurious behaviors which are manifested in the form of self-biting (of tongue, fingers, lips), eye gouging, and head-banging (Duker, 1975; Hoefnagel, 1965; Hoefnagel, Donald, Mireault, & Berndt, 1965; Lesch & Nyhan, 1964; Nyhan, Oliver & Lesch, 1965; Nyhan, Pesek, Sweetman, Carpenter, & Carter, 1967; Seegmiller, Rosenbloom, & Kelley, 1967) this syndrome is also characterized by mental retardation, choreoathetosis, hyperuricemia, and muscle spasticity (Lesch & Nyhan, 1964). Based upon the homogeneous nature of these behaviors across cases, it has been proposed that such symptoms are produced by a specific biochemical abnormality (Seegmiller, 1972; Seegmiller et. al., 1967).

**Pain Threshold.** Several reports in the literature implicate a relationship between stereotypy (particularly self-injurious behavior) and aberrations involving elevation in pain threshold. Increased production of Beta endorphin in the brain, which supposedly reduces pain experience, has been found in individuals who are self-injurious (Haywood, Meyers, & Switsky, 1982).
Riley-Day syndrome, a familial genetic anomaly associated with numerous physiological and neurological abnormalities including deficient taste perception and reduced or absent pain perception (Bergsma, 1979; Holmes, Moser, Halldorson, Cornelia, Pant, & Matzilevich, 1972) is also characterized by self-injury. Research on individuals with Riley-Day syndrome has revealed reduced levels of dopamine-B-hydroxylase, an enzyme necessary for the conversion of dopamine to norepinephrine (Cataldo & Harris, 1983).

The frequent association of otitis media (a non-genetic organic aberration) to self-injury has also been cited as evidence that these behaviors serve a pain relief function. For example, self-injury is prevalent among both humans and animals (DeLissavoy, 1963; 1964; Harkness & Wagner, 1975) with otitis media, although not all instances of otitis media lead to self-injurious behavior. Based upon their finding, Harkness and Wagner (1975) concluded that self-injurious behavior may occur only when otitis media is serious enough to inflame sensory nerve fibers. Additional support for the pain relief function of self-injury comes from the pediatric literature which suggests that head banging in normal infants is commonly preceded by eruption of the central and lateral incisors (Kravitz, et. al., 1960).
Seizure-Like Nature of Stereotypies. The compulsive, and rhythmical nature of stereotypic behaviors has led some investigators to regard them as possible manifestations of seizure-like activity originating from either structural or chemical disorders of the brain (Baumeister & Rollings, 1976). Empirical support for this hypothesis is provided through pharmacotherapy research which indicates that self-injurious behaviors are associated with injection of pemoline and caffeine, substances which are known to lower seizure threshold (Genovese, Napoli, & Bolego-Zonta, 1969; Peters, 1967). Further support is provided through anatomical studies in which self-injurious behaviors have been observed in decerebrated cats and monkeys having lesions in the temporal lobe (Lester, 1972), an area in which the most likely manifestation of seizure activity is repetitive behaviors.

Chemical Induction Theory

Stimulant Induction Hypothesis. The view that stereotyped behaviors may be mediated by neurotransmitters is based upon two lines of research, the bulk of which suggests that the pathways regulating production of stereotypic acts contains a specific neurotransmitter called dopamine and that drugs which affect stereotypy influence the function of dopamine. The first line of research involves findings that
stereotypies are elicited or enhanced by drugs which stimulate dopamine receptor sites either directly (e.g., amphetamines). The second line of research indicates that amphetamine-induced stereotypies are suppressed by postsynaptic dopamine receptor blocking agents such as neuroleptics (Iverson, 1977).

A substantial amount of research from biochemical, pharmacological, and anatomical studies suggest that induction of stereotypic behaviors by amphetamines and other dopamine mimetic agents is a result of the activation of the nigrostriatal dopaminergic system which originates in the substantia nigra and extends into the corpus striatum. This tract, the largest of the five dopaminergic systems of the brain, plays a major role in the control of fine motor movements (Lloyd & Hornykiewicz, 1975), mediation of afferent and efferent impulses, and processing of proprioceptive and vestibular information (Iverson, 1977). In fact, the characteristic of suppressing rhythmical or ritualistic movements has been used as a standard index for the efficacy of neuroleptic drugs (e.g., chlorpromazine, thiothizine, haloperidol) in treating psychotic behaviors (Lewis & Baumeister, 1983).

The neurotransmitter 5-hydroxytryptamine (a biochemical precursor to the production of serotonin), also known to mediate dopamine function, has been found to
affect stereotypic responding. For example, serotonin-related compounds have been found to induce stereotypic responding (Randrup & Munkvad, 1966) whereas lesions to the raphe nuclei of the brain which contain cells from the serotonin neuronal system have been shown to decrease amphetamine or apomorphine-induced stereotypies in animals (Costell & Naylor, 1974).

In addition to inducing stereotypic behaviors, dopamine-like agents have also been shown to enhance stereotypy. For instance, d-amphetamine has been shown to significantly increase rocking in isolation-reared primates (Berkson & Mason, 1964; Fitz-Gerald, 1967).

The action of central neurotransmitters has been proposed to account for the relationship between self-injurious behaviors and Lesch-Nyhan syndrome. Recent research on autopsies of individuals with Lesch-Nyhan syndrome have revealed increased levels of serotonin and decreased levels in both dopamine and enzymes necessary for dopamine synthesis (Lloyd, Hornykiewicz, Davidson, Shannak, Farley, Goldstein, Shibuya, Kelley, & Fox, 1981).

Another thought is that self-injury is a form of aggression produced as a result of lowered levels of serotonin, which researchers speculate is caused by the inborn error of purine metabolism (Mizuno & Yugari, 1974; Nyhan, 1976). Experimental evidence from animal models
indicates that increased aggression in rats has been observed following administration of p-chlorophenyl-
lolanine which inhibits the production of serotonin, whereas marked reduction in aggression (produced by surgical procedures) in rats has followed the administration of 5-hydroxytryptamine (Dichiara, Camba, & Spana, 1971). The use of 5-hydroxytryptamine variations in the treatment of individuals with Lesch Nyhan syndrome has resulted in notable, although limited, reductions in self-injury (Mizuno & Yugari, 1974; Nyhan, Johnson, Kaufman & Jones, 1980).

Although several attempts have been made to generalize results from animal studies to the human population, research in this area has produced some discrepancies. For example, Berkson (1965) found that varying doses of amphetamine did not affect stereotypic behaviors of blind mentally retarded subjects, whereas secobarbital tended to result in sedation.

Failure to find a significant increment in stereotypy following amphetamine administration has been reported in other studies with humans (Davis, Sprague, & Werry, 1969; Hollis, 1967). For example, Davis, Sprague, & Werry, (1969), in comparing the incidence of rocking behavior in nine severely retarded individuals across no-drug, placebo, and methylphenidate conditions, found no significant differences in target behaviors under
treatment conditions. Similarly, Hollis (1967) found no significant changes in the rates of rocking behavior in severely retarded individuals with administration of varying doses of amphetamine.

Following a thorough review of animal research in this area, Lewis and Baumeister (1983) suggested that, although the discrepancies found in the results obtained from amphetamine administration in research with humans and nonhuman primates may be due to differing etiologies and functions for these groups, a more likely explanation is that such discrepancies are due to varying degrees of drug dosages. That is, lower dosages (e.g., .38 mg/kg, .44 mg/kg) than the usual 1 to 2 mg/kg generally used in research with deprived nonhuman primates were given to humans in studies where no significant increases in stereotypies were found (Lewis & Baumeister, 1983).

Several researchers have also investigated the effect of dopamine blockers on stereotypies. In general, results in this area indicate that lower doses of thioridazine (1.3-2.5 mg/kg per day) reduced stereotypic responding (Davis, 1971; Davis, Sprague, & Werry, 1969; Singh & Aman, 1981) whereas higher doses (above 2.5 mg/kg) increased stereotypies (Singh & Aman, 1981).

Because a system of well integrated motor functions involves a balance between many neurotransmitters, the
influence on stereotypy may not be simply limited to the dopamine neurons within the striatum. Some evidence points to the role of the nucleus accumbens, a nearby dopamine terminal area. The nigrostriatal dopamine system is comprised of a loop with dopamine terminals which "act" upon acetylcholine cells which in turn act upon cells containing gamma amino butyric acid (GABA) which are located in the striatum and which send terminals to the substantia nigra where they synapse with dopamine-containing cells (Groves, Wilson, Young, & Rebec, 1975). Drugs that antagonize acetylcholine (anticholinergics) have been found to produce stereotypies of a weaker, less continuous variety than that found with dopamine agonists (see review by Lewis & Baumeister, 1983).

Methylzanthine-Induction Studies. Stereotyped behaviors in the form of self-stimulation and self-injury have been reported following chronic injection of high doses of methylzanthines such as caffeine or theophylline. Methylzanthines have been found to inhibit adenosine which is believed to be a major modulator of the central nervous system. Theophylline and caffeine have been found to significantly intensify the effects of dopamine receptor agonists such as apomorphine in animals with 6-hydroxydopamine (6-OHDA) lesions. Reports also indicate that caffeine potentiates the motor stimulation
effect of catecholamine-like drugs such as lugoteile or clonidine (Waldeck, 1973), a finding consistent with data showing that caffeine potentiates the effects of stereotypy elicited by amphetamine or apomorphine (Klawans, Moss, & Beaulieu, 1974).

Opiate-Induction Hypothesis. An important parallel to investigations of pathological stereotypic responding involves the study of the influence on stereotypic acts following administration of agents which affect opiate receptor sites. This research points to the role of neuropeptides which are believed to be closely connected to dopamine function including nigrostriatal activity (see review by Prange, Loosen, & Nemeroff, 1979), since opiate receptor sites presumably interact with endogenous peptides and also function as targets for exogenous opiates (e.g., morphine).

Overall, evidence from these studies points to the interrelated nature of stress, release of endogenous opiates, pain responsivity, and capacity of opiates to induce stereotypies in animals, supporting the potential role of a central function for opioid peptides in stereotyped behaviors of autistic and mentally retarded individuals. The peptides of greatest concern are the morphine-like peptides or opiates such as enkephalins and endorphins. Pituitary peptides such as morphin, B-endorphin, and adrenocorticotropic hormone (ACTH) which show
a high affinity for opiate receptors in the central nervous system (Gispen, Wiebant, Greven, & DeWied, 1976; Terenius, Gispen, & DeWied, 1975) have been found to elicit intense stereotypies in animals (Iwamoto & Way, 1977).

The capacity of opiate agonists to induce stereotypic responding is consistent with research findings which show that such behaviors occur in stressful situations (e.g., frustration, anxiety). Well documented scientific findings indicate that the activation of the pituitary-adrenal axis occurs in response to stress (Mason, 1968) and that endogenous morphine-like substances including neurally active peptides such as B-endorphin and ACTH are released collaterally from the pituitary in such situations to produce an inhibitory feedback effect on adrenocortical action (Hennessy & Levine, 1979; Mason, 1968). The result is that once behaviors are stabilized, the response of the pituitary-adrenal system to previously arousing stimuli can be weakened (Hennessy & Levine, 1979). Significantly related to these findings is research showing that the degree of B-endorphin concentration within amniotic fluid correlates with the level of fetal distress (Cataldo & Harris, 1982). Recent evidence suggests that excessive grooming in rodents is a secondary reaction which functions to decrease arousal
following activation by ACTH (Delius, 1970; Delius, Craig, & Chaudoir, 1976.

Endorphins, as well as being released in response to stress, mediate reaction to pain or nociceptive stimulation (Amir & Amit, 1979). Exposure to stressful stimuli has been found to increase nociceptive or pain threshold in animals as a result of endogenous opiate release (Madden, Akil, Patrick, & Barchas, 1977). The analgesic influence of pituitary peptides has also been demonstrated through studies showing lowered pain thresholds in hypophysectomized animals (Gispen, Van der Poel, & Van Wimersma Greidanus, 1973) and the blockage of stressful effects on pain thresholds by naloxone (Amir & Amit, 1979).

Opiate antagonists such as naloxone have been found to suppress stereotypic behaviors elicited by opiate agonists (Margolin & Moon, 1979; Terenius, et. al., 1975), apparently due to their greater affinity to opiate receptors (McGeer, Eccles, & McGeer, 1978). For instance, Sandman, Datta, Barron, Hoekler, and Swanson (1983) found that naloxone was effective in reducing rates of stereotypic behaviors, including self-injury, in two mentally retarded individuals. In a recent study by Richardson and Zaleski (1983) self-injurious behaviors in a 15 year old male were reduced using naloxone and remained suppressed for 2 days following treatment.
Naloxone administration has also been found to dramatically decrease the pain threshold as measured by nociceptive flexion reflex in individuals with congenital insensitivity to pain (Dehen, Willer, Boureau, & Cambier, 1977) and produce normalized responding to noxious stimulation in patients with chronic insensitivity to pain (Yanagida 1978). Analogous to this research is recent evidence (Sandman, McGivern, Berka, Walker, Coy, & Kastin, 1979) that early activity of opiate receptors causes permanent changes in pain sensitivity. Such results are not inconsistent with the developmental view in that binding site activity during a critical period of opiate development may result in permanent changes in pain thresholds. This hypothesis could be tied to the findings of DeLissavoy (1961) and Harkness and Wagner (1975) that self-injurious behavior occurs in response to painful middle ear infection since these results could be due to either absence of pain (e.g., heightened endorphin levels) or to analgesic properties (endorphin production).

The durability of stereotypies and their resistance to treatment procedures might be explained through the reinforcing/addictive properties of endorphins similar to those found in pharmacological agents (Baumeister & Rollings, 1976). For instance, the effects of endorphin release following repeated administration include
analgesia (Hosobuchi, Adams, & Linchitz, 1977), and euphoria (Belluzi & Stein, 1977), as well as physical dependence (Wei & Loh, 1976), and tolerance; all components of drug addiction (Leybin, Pinsky, & LeBella, 1976; Unger, Unger, Malin, & Sarantakis, 1977). Support for the reinforcing effect of endorphins was provided by Belluzi and Stein (1977) who found that rats would bar press for administration of enkephalin directly to the brain ventricles. Results from these studies on altered endorphin receptor sensitivity suggest that since endogenous opiates are produced in response to painful stimuli, they may be self-administered through adequately intense levels of stereotypic (particularly self-injurious) behaviors. Based upon this stereotypy/endorphin addiction hypothesis, it is possible that the endorphin system may sustain stereotypy either through enhancement of pain perception (Buchsbaum, Davis, & Bunney, 1977; Grevert & Goldstein, 1977) or stimulation of endogenous opiate production to provide pain relief.

Summary

All of the current theoretical views on stereotypic behaviors provide logical explanations for their etiology and maintenance. However, the nature of many of these theories has resulted in vague impressionistic and circular arguments. A number of problems are also inherent due to poorly developed and unsystematic methods of study.
Few empirical studies have been executed to assess the parameters of the psychodynamic theory largely due to the difficulties in effectively defining such constructs as "ego boundaries," "body reality," and "guilt" in operational terms. Isolation-rearing studies with animals (Davenport, Menzel, & Rogers, 1966; Levison, 1970; Cross & Harlow, 1965; Harlow & Griffen, 1965; Harlow & Harlow, 1962; 1971) have been cited as indirect support for the hypothesis that self-injury is the result of disruption of normal parent-child interactions. However, the basic nature of animal data undermines the symbolic functioning that theorists in this area (e.g., Miller & Swanson 1956) consider the necessary basis for such behaviors. Attempts to treat what have been considered to be underlying psychiatric disorders associated with these behaviors have been found to be unsuccessful (Bachman, 1972) and in some cases self-injury has increased following "supportive" treatment (Lovaas, et. al., 1965; Lovaas & Simmons, 1969). In addition, results from these studies may be interpreted within the realm of other theories (e.g., homeostatic developmental theories).

Conceptual circularity is also inherent in the homeostatic theory since research procedures utilized to test the formulations within this model fail to define external criteria in order to independently determine
whether a variable is actually stress inducing or stimulatory. Definitions of tension are tied directly to increase or decrease in levels of stereotypy such that increased stereotypy is interpreted as inferring that such behaviors are expressions of tension. Independent operations for determining whether an individual is receiving adequate stimulation are also lacking.

Consistent with the homeostatic theory which proposes that stereotypies are compensatory behaviors which produce an optimal level of stimulation, the developmental data suggest that some infants are typically high or low stereotypic responders (Thelen, 1980). Although the same types of situations/variables have been found to promote stereotypies in both the normal and clinical population, it is not clear that the repetitive motor movements of infancy are precursors to abnormal stereotyped behaviors seen in the clinical population since they are often hard to distinguish (see Berksen, 1983).

Within the learning theory the function of stereotypies as avoidance behavior or socially reinforced behaviors requires additional research. It is possible that stereotypy may serve both discriminative and avoidance functions in different situations. For example, self-injury may function as an attention seeking responses in conditions of social deprivation or
avoidance responses in situations which are aversive to an individual. Despite the evidence of environmental influence on stereotypic behaviors, there are many situations in which such behaviors appear to be the function of other variables (e.g., organic, neural). However, this theory has provided the most effective intervention technology to date.

While results from organic and pharmacotherapy research have shown that different chemical agents and/or lesions to the dopamine system either potentiate or suppress stereotypies, generalization of these findings to mentally retarded or emotionally disturbed individuals is difficult to make since the bulk of research in this area has been carried out on animals. Although the data on abnormalities in neuro-transmitters such as serotonin and dopamine provide the most comprehensive understanding of the biochemical nature of stereotypies, there are serious drawbacks in assuming that such behaviors are purely organically or physiologically based. One argument is that not all individuals with a known organic dysfunction (e.g., Lesch-Nyhan syndrome) evidence self-injurious behaviors (Nyhan, 1968; Segmiller, 1969, 1972) or that these behaviors are manifested in a typical form (Duker, 1975) Hoefnagel et. al., 1965). In addition, the available data suggest that pharmacological treatment procedures are not completely effective in eliciting
(Marks, Baum, Keele, Kay, & McFarlen, 1968) or controlling self-injury in Lesch-Nyhan patients (Nyhan, 1978).

The interpretation of self-injury as serving a pain relief function is not inconsistent with the negative reinforcement hypothesis of stereotypy in which ear infection may be viewed as a painful stimulus which elicits self-injurious responding. The relationship between self-injurious behavior and otitis media has also been cited in the developmental literature to support the importance of critical events suggesting that early exposure to pain may predispose a child to continue self-injurious responding following the alleviation of the ear infection (Cataldo & Harris, 1982).

The possible relationship between lesions in the CNS and stereotypic responding cannot be ruled out. However, the evidence to support an organic view is both indirect and limited. The available literature suggests that, given the wide diversity and variability of stereotypic behaviors across individuals and conditions, an organic explanation would have to be fairly broad and general in order to be considered of primary importance in explaining the etiology and maintenance of stereotypic behaviors (see review by Baumeister & Rollings, 1976).

The neural oscillator theory is supported by research showing that similar forms and topographies of
stereotyped behaviors are exhibited in individuals with widely varying diagnoses and neuropathological disorders (Wolff, 1967) and that such behaviors are very difficult to eliminate from the individual's behavioral repertoire, with long term suppression being most difficult to achieve (Baumeister, 1978). The data supporting the neural oscillator theory of stereotypic behaviors include evidence of individual stereotyped mannerisms having a predictable developmental course, their own invariant rate and frequencies, and bout lengths that are quite homogeneous (Lewis et al., 1983), suggesting that such behaviors are regulated by endogenous neural timing mechanisms as opposed to afferent feedback (also see Thelen, 1981a). This view is not inconsistent with the homeostatic theory since research in this area suggests that sensory feedback can modulate stereotypies even though the basic rhythm and tempo may be regulated by neural timing mechanisms inherent in the central nervous system (Lewis et al., 1983). While this information is useful in explaining how such behaviors might be maintained, it does not clarify origin or specify what organismic dysfunction leads to such consistent responses.

Differentiation between the various theoretical constructs on stereotypic behaviors is difficult to make since similar variables (e.g., stress/arousal) and
research (e.g., isolation rearing/deprivation studies) are cited to support arguments across theories. In addition, there is generally no clear distinction made between etiological variables and those that maintain stereotypies. It could thus be argued that these theories are mutually inclusive and the origin and maintenance of stereotypic behaviors is based upon a biobehavioral interaction (Cataldo & Harris, 1982). Whereas rates of stereotypic behaviors may be affected by instrumental conditioning or specific stimulus events, these conditions alone are not sufficient evidence to prove that such behaviors originated through learning. On the other hand, there is evidence to indicate that physiological functions such as oscillator frequencies and heart rate can be modified through stimulus conditions (Baumeister & Forehand, 1976) (Bekoff, 1978).

**Intervention Techniques**

Numerous studies have been carried out to suppress stereotypic responding among the clinical population. Although these have included some pharmacotherapy research (see Chemical Induction Theory), for the most part these techniques have involved behavioral strategies. Generally the behavioral strategies utilized are grouped into six broad categories; (a) reinforcement procedures (e.g. differential reinforcement of alternative behaviors, sensory stimulation), (b) overcorrection
(c) withdrawal or withholding of positive reinforcement (e.g., time out from positive reinforcement, response cost, and extinction), (d) physical restraint, (e) punishment (e.g., electrical shock, bitter substance, aromatic ammonia, aversive tickling, and water mist), and (f) combinations of two or more behavioral treatment procedures. In addition to these direct interventions, various setting events have also been found to affect stereotypic responding including those that are associated with increase (noise level, stimulus restriction/deprivation) and those associated with decrease (sensory stimulation, object manipulation, social/environmental conditions) in these behaviors.

**Reinforcement Procedures**

Differential reinforcement (DRO/DRI). Differential reinforcement of alternative behaviors consists of eliminating maladaptive behaviors by increasing socially appropriate behaviors. This involves provision of positive reinforcement for adaptive behaviors and delay of reinforcement following episodes of stereotypy as an attempt to weaken stereotypic responding. One form of this approach, Differential Reinforcement of Other Behaviors, (DRO), involves provision of reinforcement following a specified period in which no stereotypy has occurred. This technique represents a reductive schedule in which omission of the target behavior is reinforced.
(Kelleher, 1961; Lane, 1961; Reynolds, 1961). DRO has also been called "omission training". Another form of the differential reinforcement approach, Differential Reinforcement of the Incompatible Behaviors (DRI), serves a dual purpose which involves provision of reinforcement for behavior which is both inappropriate and incompatible with stereotypy along with the absence of the target behavior during a given time period.

Although there have been variations in the application of differential reinforcement procedures several studies have shown these to be effective treatments for topographically different stereotypic behaviors including head banging (Frankal, Moss, Schofield, and Simmons, 1976; Lovaas et al., 1965, Peterson & Peterson, 1968, Warren & Burns, 1970; WeiHar & Harman, 1975), self-scratching (Allen & Harris, 1971; Ragain & Aronson, 1976; Repp & Deitz, 1974), head slapping (Brawley, at. al., 1969; Luiselli, Pemberton, & Helfen, 1978; Peterson & Peterson, 1968; Ragain & Aronson, 1976), nail biting (Lane & Damrath, 1970), body rocking (Baumeister & Forehand, 1971; Hollis, 1968, Mulkern & Baumeister, 1969), hand gesturing (Weisberg, Passman, & Russell, 1973), and wrist and finger biting (Luiselli, et. al., 1978).

Additional investigations have shown differential reinforcement of appropriate behaviors to be effective in
both decreasing stereotypic behaviors and increasing adaptive behaviors. Eason, White, & Newsom, (1982) have found that differential reinforcement of toy play was effective in reducing self-stimulatory behavior and increasing toy play in six retarded and autistic children. Freschi and DiLeo (1982) used a positive interference procedure consisting of redirecting inappropriate behaviors into positive activities to reduce self-injury in a 9 year old autistic boy. Mithaug and Hanawalt (1977) used DRO to increase prevocational task behavior and decrease self-injurious behavior in a 19 year old severely retarded girl. Mulick, Hoyt, Rojahn, and Schroeder (1978) systematically reinforced toy play in a profoundly retarded blind adult in order to eliminate mild self-injurious behavior (finger picking, nail biting). Similarly, Singh, Dawson, and Manning (1981) used spaced responding DRL to effectively reduce stereotypic behaviors and to increase appropriate social behaviors. A number of additional reports describe the effectiveness of various forms of positive reinforcement for strengthening alternative responses and reducing stereotypy (Azrin, Kaplan, & Foxx, 1973; Brawley, Harris, Allen, Fleming & Peterson, 1969; Nordquist & Wahler, 1973; Peterson & Peterson, 1968; Repp, Deitz, & Deitz, 1976; Tate, 1972), and self-injury (Nolley, Butterfield, Fleming & Muller, 1982).
In some studies use of DRO to treat stereotypic behaviors has revealed negative findings (Herendeen, Jeffrey, & Graham, 1974; Foxx & Azrin, 1973). Herendeen, et al., (1974) found that, although rocking behavior decreased by nearly one-half in one of two retarded children, a concurrent increase in mouthing was noted. With the second subject, the same procedure (using food and praise) was ineffective in reducing self-stimulatory mouthing. Foxx and Azrin (1973), found only a slight decrease in mouthing of two severely retarded children when food and praise were presented following a 10 second latency period. Weisberg, Passman and Russel (1973) achieved reductions in self-stimulatory hand gestures in two severely retarded adults using a DRI procedure (in the form of food and praise) whereas collateral forms of self-stimulation increased.

A second problem with this procedure is identification of strong reinforcers which can compete with the reinforcing effects of stereotypy, particularly if the often held conceptual view of self-stimulation as self-reinforcing (Lovaas, Litrownick, & Mann, 1971) is legitimate. In addition, the physical and/or sensory deficits which are characteristic of many individuals who exhibit stereotypic acts can limit the pool of reinforcers to draw from.
A third limitation of the DRO procedure is that stereotypies can occur at such high rates that there are few occasions to reinforce desirable behaviors. For instance, Miron and Rooney (1973) reported a case of one retarded individual in which rates of self-injury were so high that reinforcement was often delivered just after the subject emitted a sudden thrust of self-injurious behavior.

A fourth limitation is that, like many other behavioral treatment procedures, the DRO approach is generally situation and/or trainer specific and does not often generalize beyond the treatment setting. However, some investigators have reported successful generalization. Weihar and Harman (1975) reported generalization of DRO effects following reduction of self-injury in a 14 year old psychotic boy. Frankel et al., (1976) also reported generalization outside the laboratory setting in a 7 year old girl.

A fifth limitation is that little attention has been given to the durability of treatment. Based upon their own studies, Baumeister and Forehand (1973) suggested that once reinforcement of alternative behaviors is no longer available, stereotypies increase to rates higher than those evidenced prior to treatment.

Although both DRO and DRI procedures involve provision of reinforcement, occurrence of stereotypy
delays reinforcement. As stereotypy decreases, the amount of time between reinforcement is gradually increased. However, in many cases differential reinforcement is effective in reducing stereotypies only after an extended period of time spanning weeks or months (Peterson & Peterson, 1968), and regularly fails to suppress severe self-injurious behaviors (Muttar, Peck, Whitlow, & Fraser, 1975). Some researchers have achieved rapid and dramatic suppression with differential reinforcement, however, reinforcement of alternative behaviors alone may not be sufficient to suppress stereotypy in all cases (Young & Wincz, 1974). Generally, the compliance of a subject and degree of incompatibility of alternative behaviors appears to be related to the effectiveness of DRO and DRI procedures (Tarpley & Schroeder, 1979). In situations where rapid control is achieved, differential reinforcement must be continued which may be difficult to arrange.

There are several advantages to DRO procedures. First, consequation of appropriate behavior can be fairly easily faded to natural contingencies by gradually increasing the length of time between non-occurrence of stereotypy (Poling, Miller, Nelson, & Ryan, 1978). Second, differential reinforcement promotes development of appropriate behaviors while suppressing maladaptive behaviors (Piche, et al., 1979). Third, positive
reinforcement procedures are considered ethical and can be accomplished in various settings. Overall, DRO techniques appear to be effective with moderately high rates of responding (Repp, Dietz, & Soeur, 1974), when used in combination with other procedures (Barkley & Zupnick, 1976; Horner, 1980; Repp et. al., 1974) and when used alone if the initial length of interval is adequately short to provide enough opportunities for reinforcement (Repp, et al, 1976).

Generally, differential reinforcement procedures are used in combination with other techniques which typically involve application of some consequence following stereotypy. The bulk of research literature supports the use of differential reinforcement in conjunction with other techniques (Brawley et al., 1969; Favell, et al., 1978; Myers, 1975; Myers & Deibert, 1971; Peterson & Peterson, 1968; Repp & Deitz, 1974). However, this combination treatment package makes evaluation of the differential reinforcement contingency alone difficult to assess (Baumeister & Rollings, 1976). In the few studies where differential reinforcement techniques (DRO and DRI) were implemented alone they were found to be effective in some cases (Allen & Harris, 1966; AABT Task Force, 1982; Frankel, Moss, Schofield, & Simmons, 1976; Lane & Domrath, 1970; Lovaas et al., 1965; Tarpley & Schroeder, 1979; Weihar & Harman, 1975) but ineffective in others
Comparative and Combination Treatment Studies. A few comparative studies have assessed the effectiveness of differential reinforcement with various treatment procedures. Corte, et al. (1971) in comparing the effectiveness of extinction, DRO and contingent shock on four subjects found that shock was most effective for all four subjects whereas DRO was effective in reducing self-injury. Myers (1975), in comparing the effectiveness of extinction, DRO, and response cost on finger biting of a 12 year old boy found that extinction was ineffective whereas DRO was effective, however, the greatest reduction was attained with the response cost procedure. Lucero, Frieman, Spoering and Fehrenbacher (1976) compared the effectiveness of time out from food, time out from attention, and time out from both in treating the self-injurious behavior of three profoundly retarded girls. Results indicated that behaviors were lowest across conditions involving withdrawal of food.

In a direct comparison between DRO and DRI procedures of three profoundly retarded head bangers Tarpley and Schroeder (1979) found that DRI, was more effective in suppressing self-injurious behavior than DRO, which in turn was more effective than extinction. Ragain and Aronson (1976) found that contingent DRO was
effective in reducing self-scratching in a 12 year old child but that non-contingent DRO resulted in a noticeable increase in self-scratching. Similar results were reported by Weiher and Harman, 1975).

Harris and Wolchik (1979) in comparing the effectiveness of time out, DRO and overcorrection on the stereotypic behavior of four boys found that one subject was responsive to DRO whereas target behaviors of three subjects decreased in response to time out. However, the most dramatic reduction in all four subjects occurred with overcorrection. Richmond and Bell (1983) in comparing DRO with a response interruption/physical restraint treatment package found no reduction in hand-mouthing with DRO whereas this behavior decreased in response to the interruption/restraint procedure. However, the greatest reduction occurred with the combination of these procedures. Barrett, Matson, Shapiro and Ollendick (1981) in comparing the effectiveness of DRO and visual screening found visual screening to be more effective in reducing stereotypic behavior in two mentally retarded children. Rapoff, Altman and Christopherson (1980) compared the effectiveness of DRO, overcorrection, lemon juice, and aromatic ammonia on self-poking in a profoundly retarded child and found lemon juice and aromatic ammonia to be most effective in suppressing self-injurious behavior.
Fleming and Nolley (1981) compared the effectiveness of several different treatment procedures including contingent mechanical restraint plus omission training utilizing DRO, DRI, verbal reprimand plus restraint jacket, and DRO plus contingent restraint. DRI plus boxing glove restraints were found to be the most effective in suppressing self-scratching in the subject, a mildly retarded woman. Gaylord-Ross, Weeks, Lipner and Gaylord-Ross (1983) compared the effectiveness of four treatment procedures including DRI, omission training, reinforcement withdrawal, and contingent restraint on self-injurious behaviors of 22 severely handicapped students. Restraint was found to be the most effective of these treatments although positive reinforcement and reinforcement withdrawal were less successful. Cavalier and Ferretti (1980) compared the effectiveness of four treatment procedures including a mild slap to the forearm, DRO, overcorrection plus DRO, and mild slap plus DRO in stereotyped behaviors of a profoundly retarded 5 year old girl. The mild slap plus DRO was found to be the most effective of these procedures in suppressing stereotypic behavior to near zero rates with some evidence of generalization across trainers, settings, and time. Wesolowski and Zawlocki (1982) conducted 2 studies to investigate the effectiveness of 4 procedures for reducing self-injurious eye-gauging in 6 year old blind
retarded twin girls. Results showed that time out from auditory stimuli was more effective than response interruption, in reducing the targeted behavior, whereas auditory time-out plus DRO eliminated eye gauging in about 5 days. Overcorrection plus DRO employed 1 year later resulted in suppression within 2 weeks.

Several investigators have combined procedures within a treatment package to reduce stereotypic behaviors. This involves treatment with multiple components that may or may not have a central focus. Although this presents an efficient way to reduce target behaviors, it makes assessment of the effective components of this package difficult to evaluate. Combinations found to be effective in reducing stereotypic behaviors include DRO plus extinction (Anderson, Dancis, & Alpert, 1978; Rubin, Griswold, Smith & DeLeonarda, 1972; Thomas & Howard, 1971); DRO plus time-out (Brawley, et al., 1969, Duker, 1975b); DRO with a verbal reprimand ("no") and physical interruption (Repp & Dietz, 1974); DRO plus overcorrection (Azris, et al., 1975; DeCatanzaro & Baldwin, 1978); DRO plus contingent shock (Tate & Baroff, 1966); DRO plus restraint (Freeman, Graham, & Ritvo, 1975; Saposnek & Watson, 1974) and DRO plus shock and time-out (Tate, 1972). In only two cases were combination procedures found to be ineffective (Romanczyk & Goren, 1975; Measel & Alfieri, 1976).
Sensory Stimulation. In a few studies sensory stimulation has been used as a reinforcer to reduce stereotypic responding. Hung (1978) used varying periods of self-stimulation as reinforcement in exchange for tokens provided contingent upon production of appropriate spontaneous sentences resulting in both an increase in sentence production and a decrease in self-stimulation. Wolery (1978) delivered sensory stimulation, similar to that acquired during self-stimulation of one autistic and one severely retarded child as reinforcement for correct response to a manipulative task resulting in successful increase in desired behavior. Burkhart (1980) showed that reduced rates of stereotypic behaviors were associated with presentation of pre-vocational tasks which incorporated behaviors that were topographically similar to the targeted stereotypic response as opposed to pre-vocational tasks which were topographically dissimilar. Favell, McGimsey, and Schell (1982) also treated several forms of self-injury including mouthing, eye poking, and pica in six profoundly retarded subjects through provision of alternative sensory activities. In contrast to these results Lancioni, Smeets, Ceccarani, and Goossens (1983) found that application of sensory or edible/liquid reinforcement contingent on low rates of task related respondings did not increase these behaviors or reduce stereotypic hand flapping, head
weaving, and finger mobility in three severely retarded children.

Vestibular Stimulation was found to be effective in reducing both frequency and duration of stereotypic rocking in 3 severely retarded individuals in a study by Bonadonna (1981) immediately and one hour following treatment within both laboratory and naturalistic settings. Wells and Smith (1983) found that the frequency of self-injury decreased significantly in four profoundly retarded institutionalized individuals following daily sensory integration treatment which included non-contingent tactile and vestibular stimulation. Similarly, Bright, Bittick, and Fleeman (1981) found that non-contingent application of a sensory integration technique plus soft protective restraint significantly reduced face hitting in a 28 year old profoundly retarded institutionalized individual.

Vigorous exercise (Ohlson, 1978) and brief jogging (Kern, Koegel, Dyer, Blew, & Fenton, 1982) has also been found to reduce stereotypic responding and increase appropriate work/play behaviors.

Overcorrection

The overcorrection technique is one of the most popular and most commonly used behavioral treatment strategies for stereotypies. This procedure, first developed by Foxx and Azrin (1973), refers to either
restitutional overcorrection which requires the individual to restore the environmental effects of the inappropriate behavior or Positive Practice Overcorrection which requires practice of functional motor responses which are incompatible with the stereotypic behaviors (Azrin, Kaplan, & Foxx, 1973; Doke & Epstein, 1975; Foxx & Azrin, 1972; 1973; Webster & Azrin, 1972). Required relaxation is another form of Positive Practice Overcorrection (Azrin & Wesolowski, 1975). The rationale of this procedure which distinguishes it from other aversive procedures is that it requires the individual to be responsible for his/her inappropriate behaviors and to engage in more socially appropriate responses.

There are several components which have been identified in the overcorrection procedure including negative feedback, extinction, time out from positive reinforcement, response prevention, negative reinforcement, verbal instructions, compliance training, prompting, reinforcement of alternative responses, and alteration of the social environment. (Baumeister & Forehand, 1973; Epstein, Doke, Sajway, Sorell, & Rimmer, 1974; Hobbs, 1976). Success of this procedure has been attributed to several aspects including direct relationship to inappropriate behaviors, requirement of effort, immediate application following misbehavior,
lengthy duration, rapid performance such that the procedure is inhibiting (Schroeder, et al., 1981), and withholding of positive reinforcement until overcorrection is completed (Favell, et al., 1982).

Foxx and Azrin (1973) first applied the overcorrection procedure to self-stimulatory behaviors (i.e., object/hand mouthing, head weaving and hand clapping) in four retarded/autistic children. Restitutional (oral hygiene) overcorrection applied to mouthing behaviors consisted of brushing gums and teeth with antiseptic solution and wiping lips for two minutes with a washcloth. Positive practice overcorrection was used in guiding head and hands through functional motor acts for five minutes. Although self-stimulation was reduced in three of the children, the positive practice procedure was increased in the fourth subject to twenty minutes before a reduction in head weaving was noted. Doke and Epstein (1975) also employed restitutional (oral hygiene) overcorrection in reducing self-stimulatory hand mouthing in two behavior disordered retarded children. Azrin and Wesolowski (1975) demonstrated the effectiveness of restitution (cleaning up) and positive practice (vomiting in toilet) overcorrection in reducing vomiting behavior of a profoundly retarded woman. Duker and Seys (1977) also found a reduction in vomiting behavior of a subject using a 20 minute overcorrection
Azrin, Kaplin and Foxx (1973) used a combination of positive reinforcement for appropriate play plus a twenty minute positive practice overcorrection procedure to reduce self-stimulatory behavior (i.e., rocking, head weaving and finger/hand manipulations) of nine severely and profoundly retarded adults. Reinforcement for appropriate play was effective in reducing stereotypic behaviors from 75% of the time samples in baseline to 26%, whereas the addition of positive practice overcorrection resulted in total suppression of stereotypic responding. Similar results were obtained by Ollendick, Matson and Martin (1978) with two retarded adults who exhibited excessive hand shaking and nose touching.

Kissel and Whitman (1977), who studied the effects of positive reinforcement for appropriate play and positive practice hand overcorrection on the stereotypic behavior of a 14 year old profoundly retarded boy, reported that these combined procedures effectively reduced stereotypy in structured and free play but not in solitary play situations. A similar study by Coleman, Whitman, and Johnson (1979) examined the direct and generalized effects of positive reinforcement and a modified arm overcorrection procedure on a 17 year old profoundly retarded male. Results indicated that this
combined procedure produced an increase in appropriate play and a decrease in stereotypy.

Freeman, Moss, Somerset and Ritvo (1977) used positive practice overcorrection to reduce excessive thumb sucking in an autistic child. Similar success with positive practice overcorrection has been reported by Luiselli, Helfen, Pemberton and Reisman (1977) in eliminating masturbation in a mentally retarded behaviorally disturbed child; by Wells, Forehand, Hickey and Green (1977) in reducing inappropriate object manipulation, hand movements and mouthing in two autistic children; by Martin, Weller and Matson (1977) in decreasing self-stimulatory object transferring in a 27 year old profoundly retarded female, and by Higgs, Burns and Meunir (1980) to reduce self-stimulatory vocalization of a 9 year old profoundly retarded blind girl.

Several investigations have focused on the effects of topographically similar versus dissimilar stereotypic movements in employing positive practice overcorrection. Ollendick, Matson and Martin (1978) found that positive practice hand overcorrection was effective in reducing the frequency of two similar (hand shaking and nose touching) and two dissimilar (laughing and head weaving) self-stimulatory behaviors in four severely retarded adults. Results indicated that this procedure was more effective in treating topographically similar self-
stimulatory behaviors. Similarly, Epstein, Doke, Sajway, Sorrell and Rimmer (1974) reported decrements in similar (hand movements) and dissimilar (foot movements) self-stimulatory behaviors and increase in toy play using a hand overcorrection procedure in treating two schizophrenic children.

The first systematic application of overcorrection to self-injurious behaviors was provided by Webster and Azrin (1973) in two profoundly retarded adults using two-hour required relaxation for self-biting and self-hitting in one subject and self-hitting/kicking, head banging, and running into objects in the other. While not immediately effective, this procedure eventually was reported to have resulted in nearly complete and enduring suppression of self-injurious behaviors (Webster & Azrin, 1973). Positive Practice Overcorrection was successfully employed by Harris and Romanczyk (1976) to reduce head and chin banging in a rubella syndrome child, by Freeman, Graham and Ritvo (1975) to eliminate excessive nail picking in an aphasic child; by Kelly and Drabman (1977) to reduce high rate eye poking in a visually impaired child, by Singh, Dawson and Gregory (1980) to reduce repetitive jaw-hitting in a 16 year old retarded female, and by Harris and Romanczyk (1976) to reduce head banging in an 8 year old retarded boy. Positive Practice Overcorrection was also used by Conley and Wolery (1980)
to successfully treat self-injurious eye gouging in a 5 year old blind boy and a 7 year old severely retarded girl. Barrett and Shapiro (1980) used Positive Practice Overcorrection paired with a verbal warning to reduce stereotypic hair pulling in a 7 year old severely mentally retarded girl with continued suppression at one year follow-up. This study was based upon similar results attained on an adult by Matson, Stephens and Smith (1978).

Other forms of overcorrection have also been successfully employed for the treatment of self-injurious behaviors. Azrin, Gottlieb, Hughart, Wesolowski and Rahn (1975) compared the effectiveness of two variants of Positive Practice Overcorrection in the treatment of 11 institutionalized retarded residents. A 2 hour required relaxation was employed for 6 of the subjects while 30 minute functional movement training was employed for the remaining 5 subjects. Required relaxation was found to be effective in reducing self-injury for three of the six subjects in this group, but for the remaining three rates of self-injury increased. Functional movement overcorrection was found to be effective in reducing self-injury in the 5 subjects assigned to this treatment as well as the three who did not respond to required relaxation.
Researchers in recent years have begun to investigate the effectiveness of overcorrection in comparison to other procedures. For example, Measel and Alfieri (1976) and DeCatanzaro and Baldwin (1978) examined the effects of DRO and overcorrection procedures. Although results from these studies suggest that the combination of DRO and overcorrection was more effective than either procedure presented alone, neither study controlled for order effects, thus limiting the strength of conclusions drawn. Richmond (1983) found a DRO plus overcorrection treatment package to be effective in reducing hand-mouthing behavior in all of three profoundly retarded women with durable maintenance in two of the three subjects.

Luiselli, Pemberton and Helfen (1978) compared the effectiveness of DRI alone and a combination DRI/positive practice overcorrection treatment package on self-stimulation (e.g., tapping, rubbing, waving, slapping hands) of a 10 year old moderately retarded boy. DRI alone resulted in a reduction in rubbing from 32% of the intervals in baseline to 19%, in waving from 9% to 3% and elimination of slapping from 9%, whereas tapping increased from 32% to 48%. DRI plus Positive Practice Overcorrection resulted in a further reduction in rubbing to 16% and tapping to 5%, whereas waving increased slightly to 9%.
Denny (1980) studied a variation of the overcorrection procedure on the stereotypic behaviors of three profoundly retarded nonambulatory institutionalized children. For two subjects in which stereotypic behaviors averaged 81% during sampled baseline intervals, DRI reduced these behaviors to 58% while wheelchair mobility further reduced these behaviors to a mean of 1%. For a third subject where wheelchair mobility was not used, DRI resulted in a reduction in stereotypy to 2% from a mean baseline rate of 97%. Positive Practice Overcorrection was applied in combination with physical therapy training by Barrett and Linn (1981) to reduce stereotypic toe walking from a mean of 100% during baseline assessment to 5% in a 9 year old moderately retarded boy.

Overcorrection has been applied effectively using durations ranging from 10 seconds (Foxx and Azrin, et al., 1973; Freeman, et al., 1975) to 55 minutes (Epstein, et al., 1974). In an attempt to compare the effectiveness of the different lengths of overcorrection treatment in a multielement design, Holvoit (1977) found that 2 minutes of overcorrection produced more favorable results than 20 minutes in one child, but replication attempted with a second child was unsuccessful. Marholin and Townsend (1978) found that both 3 and 5 minute durations of the physical restraint component of
overcorrection resulted in a dramatic suppression of twiddling. Luiselli, Suskin and McPhee (1981), in assessing their schedule of positive practice overcorrection in treating the self-injurious behavior of a 10 year old autistic boy, found that, although intermittent overcorrection reduced self-injury from baseline rates, the continuous schedule of overcorrection produced the greatest response reduction.

Dramatic increases in untreated self-stimulatory behaviors (Doke & Epstein, 1975; Epstein, et al., 1974; Weisberg, et. al., 1973) and occurrence of new forms of self-stimulation and/or self-injurious behaviors (Rollings, Baumeister & Baumeister, 1977) have been reported with the use of this procedure. Doke and Epstein (1975) reported a noticeable increase in inappropriate behaviors such as noise making, rocking, face slapping and masturbation following threats to administer an overcorrection procedure previously used for mouthing. In studying two institutionalized adult males, Rollings, et al., (1977) found that head nodding and self-hitting occurred in one subject when overcorrection was used to treat rocking behavior. In the second subject overcorrection for head weaving was associated with an increase in emotional behaviors such as screaming, self-pinching and self-scratching. Similarly, Measel and Alfieri (1976) found that Positive
Practice Overcorrection was effective in reducing head slapping in one of two profoundly retarded boys, whereas a rapid increase in head banging occurred in the second subject. Bernard, Christophersen and Wolf (1976), who taught parents to use a variation of oral hygiene restitutional overcorrection to treat stereotypic head banging and hand biting in the home, found that whereas target behaviors were reduced in 2 subjects, head banging did not decrease in the third subject despite the increase in duration of overcorrection from 7 to 14 minutes. Occurrence of such negative responses have been reported in several other investigations which have studied changes in untreated behaviors (Harris & Wolchik, 1979; Wells, et al., 1977).

Few investigations have demonstrated changes in targeted behaviors at times other than the treatment sessions involving overcorrection. According to several investigators, (Foxx & Azrin, 1973; Rollings, et al., 1974); (1977) generalization generally does not occur unless programmed. Matson, Ollendick and Martin (1979), in a one year follow-up of eight profoundly retarded adults who had previously responded to positive practice overcorrection for various stereotypic behaviors found that although suppression was maintained in 2 of the subjects, frequency of stereotypic behaviors in the remaining 6 subjects had returned to near baseline rates.
Harris and Wolchik (1979) failed to reveal any
generalization across settings in a treatment involving
time-out, DRO, and overcorrection. Simpson, Swensen and
Thompson (1980) found that treatment effects failed to
generalize across settings in a study designed to analyze
academic performance as a function of a parent applied
procedure for reducing stereotypic behaviors in 3
autistic-like male children. Bellamy (1977) found that
employing a positive practice overcorrection procedure to
reduce self-stimulatory behavior of a 38 year old
severely retarded woman in a sheltered workshop, rates of
self-stimulatory behavior, were significantly reduced in
contrast to maintenance of consistently high rates of
self-stimulation in the home setting.

Other investigators have found difficulty in
maintaining use of this procedure in applied settings.
Zehr and Theobald (1978) were able to reduce self-
inejurious behaviors in 2 profoundly retarded girls
through a 3 minute Positive Practice Procedure. However,
no generalization was found and treatment had to be
discontinued because hospital staff were unwilling to
implement the procedure. Similarly, Kelly and Drabman
(1977) found difficulty in maintaining use of the
Positive Practice Overcorrection Procedure following
reduction of head striking in a 10 year old retarded
girl. The program was therefore discontinued and at 6 month follow-up the behavior had returned to baseline rates.

In spite of these complications, some researchers have reported generalization of their treatment across settings using additional aides. Duker and Seys (1977) generalized their treatment through an aide trained to implement the overcorrection procedure throughout the day. Harris and Romanczyk (1976) generalized the effectiveness of their treatment by carrying out the procedure 24 hours per day through an aide at school and the mother at home.

Overall, current research suggests that overcorrection is effective in producing rapid and, in many cases, enduring effects (Harris & Romanczyk, 1976; Measel & Alfieri, 1976; Webster & Azrin, 1973). Several studies have used a number of controls which support the efficacy of this procedure. However, most of these procedures used different components within the overcorrection package, making comparison across experiments difficult.

Withdrawal/Withholding of Positive Reinforcement

Procedures which involve withdrawal of reinforcement contingent upon the occurrence of stereotypy include time-out, response cost, and extinction.
**Time-Out.** Time out consists of removing the individual from the opportunity to obtain reinforcement contingent upon the occurrence of the behavior. Several different time out procedures have been used for treating stereotypic behaviors including contingent withdrawal of the caretaker from the environment (Tate & Baroff, 1966), contingent removal of the client from an activity to a barren area (White, Nielson, & Johnson, 1972), contingent observation, withdrawal time out, seclusionary time out, and contingent restraint time out (Mulick & Schroeder, 1979).

Time out has been found to be effective in reducing stereotypic behaviors primarily in situations where reinforcement or an enriched environment is also provided (Adams, Klinge, & Keiser, 1973; Anderson, Herman, Alpert & Dancis 1975; Brawley, et. al., 1969; Myers & Deibert, 1971; Wolf, et. al., 1967; Wolf, et. al., 1964). However, in other cases it has been found to be ineffective (Corte, et al., 1971; Tate & Baroff, 1966).

Pendergrass (1972) employed a two minute isolation procedure to decrease the rate of string twirling and toy banging in two severely retarded children while Sachs (1973) used both isolation and extinction in treating self-stimulatory spinning and head weaving in a 13 year old emotionally disturbed boy. Although reduction of targeted behaviors was noted in relation to contingent
isolation in both studies, use of this procedure was also accompanied by negative affects including severe temper tantrums.

Investigating the parameters of time-out is difficult since it is hard to identify time-in parameters. It is likely that the success of time out depends on both reinforcement and punishment aspects. For instance, Birnbauer (1976) suggested that the main component of time out may be disruption of a chain of inappropriate behaviors and that the effective duration may interact with other parameters such as inhibition of responses, contingent release, and the reinforcing nature of time in.

The periods of time an individual is placed in time out have varied from a few seconds to several minutes (AABT Task Force, 1982). Effective time out procedures have reportedly ranged from 90 seconds to 30 minutes (White, et. al., 1972; Williams, Schroeder & Rojahn, 1978). Wolf, et al., (1967) used a time out varying from 2 to 45 minutes to suppress head-banging, face slapping, and hair-pulling in a 3 year old autistic boy. Hamilton, et al., (1967) used a 30 minute time out procedure for head banging in one severely retarded girl and a 2 hour bed restraint for the body slamming of another. Head banging was nearly eliminated in three weeks and maintained at nine months follow-up whereas body slamming
was eliminated in seven months and remained at near zero rates at two months follow-up. Duker (1975) found that a 20 minute time out with DRO was effective in suppressing head banging in a 15 year old retarded girl within 60 days of treatment. White, et al., (1972), in comparing the parameters of time out on four classes of inappropriate behaviors, found that 15 minute duration was superior to a 1 minute time out procedure but no better than a 30 minute duration. However, McFarlain, Andy, Scott & Wheatley (1975) reported that both 1 minute and 5 minute time out procedures were ineffective in suppressing the self-injurious behavior of a profoundly retarded male.

Although time out has been found to be effective in treating stereotypic behaviors, several factors limit its application. First, a time out procedure, as with extinction, is a slow process often requiring extended treatments in controlling stereotypic behaviors (Hamilton, et al., 1967; Wolf, et al., 1964), therefore posing a threat of physical harm to an individual who engages in severe self-injury. Second, time out is considerably demanding of staff since the individual must not only be placed in time out but be monitored to prevent self-injury. Oftentimes time out requires additional devices in the form of isolation areas or cubicles (Poling, Miller, Nelson, & Ryan, 1978). Third,
time out can serve as a reinforcer in rare instances (Dardano, 1973) such as in autistic children who do not generally respond to withdrawal of social reinforcers and may engage in behavior to get this technique implemented in an effort to avoid required activities. Fourth, time out is a very restrictive procedure requiring special consideration of ethical and legal issues (Martin, 1975). Fifth, time out often fails to generalize outside the treatment setting (Tate & Baroff, 1966).

There are however, some advantages to using time out over other treatment procedures. Time out is less aversive than other treatment procedures and can be carried out briefly and painlessly. The available research also reveals that brief time out of only a few minutes duration can be effective.

Response Cost. Response cost refers to the removal of specific reinforcers contingent upon the occurrence of the target behavior. Several studies have shown withdrawal of food and attention to be effective in reducing head banging and head hitting (Lucero, et. al., 1976) and face slapping (Brawley, et. al., 1969). Response cost of vibratory stimulation was found to be effective in reducing self-slapping (Nunes, Murphy, & Ruprecht, 1977) mouthing, hyperventilation (Murphy, et. al., 1977), and mouthing with rumination (Barmann, 1980). Withdrawal of hand holding was also found to be effective
in almost totally suppressing head banging and face slapping (Tate & Baroff, 1966).

Augustine and Cipani (1982), in comparing the effects of Response Cost and DRO on the self-injurious behaviors of an 18 year old severely retarded male found that DRO alone was effective in reducing targeted behaviors but that reduction to near zero rates was not attained until the response cost procedure was added to DRO. In another comparative study Meyers (1975) found a response cost procedure involving loss of tokens to be more effective than DRO or extinction in almost totally eliminating stereotypic finger and nail biting in a 12 year old retarded boy.

Although response cost appears to be effective in treating stereotypic behaviors, its efficacy has been demonstrated in only a few studies. In addition, this procedure, as with other procedures which involve withdrawal of strong positive reinforcers, is plagued by the potential of producing negative side effects (Singh, 1981). Another drawback to using this procedure is that it is only effective when a specific reinforcer can be identified and systematically controlled (Whitman, Scibak & Reid, 1983).

**Extinction.** Extinction involves withdrawal or withholding of positive reinforcement from previously reinforced behavior (Singh, 1981). Although extinction
has been found to be effective in reducing stereotypic behaviors in a few studies (Anderson, et. al., 1975; Jones, et. al., 1974; Lovaas & Simmons, 1969), it has been found only partially effective (Duker, 1975) or ineffective in others (Bucher & Lovaas, 1968; Corte, et. al., 1971; Meyers, 1975). These inconsistent results may be due to several drawbacks which limit the usefulness of this procedure for treating some forms of stereotypic responding.

First, use of extinction presupposes that the individual has a history of reinforcement for the target behaviors (Schroeder, et. al., 1981). Second, when extinction is successful in suppressing stereotypy, its effects are situation-specific (Lovaas & Simmons, 1969). Third, potential occurrence of adventitious reinforcement must be controlled. For instance, Lovaas, et al., (1965) found that noncontingent ignoring of self-injury did not control for this behavior. Fourth, extinction can result in serious side effects such as emotional responses, agitation, frustration, rage, and aggression (see review by Singh, 1981). Finally, this procedure poses potential risk to subjects since an individual may injure himself or herself during treatment. It is ethically questionable as a treatment for severe high rate self-injury, unless precautions can be taken to protect the client from injury (Rincover & Devany, 1982).
Lovaas, Frietag, Gold and Kassorla (1965) demonstrated that use of an extinction procedure with high rates of self-injurious behaviors could result in severe physical damage to subjects. Lovaas and Simmons (1969) noted that a total of 25,000 and 9,000 responses were exhibited by the two subjects in their study before target behaviors were suppressed. Similarly, Jones, et al., (1974) found that 6 months of treatment was required to suppress stereotypic behaviors in their research using the same technique.

Use of extinction for self-injury is additionally questionable given that it can result in an initial burst in target behaviors before maintenance occurs (Watson, 1967). This increase involves a lengthy period to take effect and depends on a number of factors including reinforcement history, length of time the behavior was reinforced, and previous attempts to use extinction. The limitations and serious drawbacks associated with the procedure have been cited for generally ruling out its use in treating self-injury (Bucher & Lovaas, 1968; Lovaas, et al., 1965).

**Sensory Extinction.** Sensory extinction involves interruption of the sensory stimulation which occurs as a result of stereotypic responding (Rincover, 1978). Studies in this area have focused upon removing sensory consequences of stereotypic object twirling in one
subject by carpeting the table (Rincover, 1978; Rincover, Cook, Peoples, & Packard, 1979) and by removing the tactile stimulation from head banging and face slapping in three other subjects (Rincover & Devaney, 1982). Additional examples include masking the proprioceptive feedback from stereotypic finger and arm movement by attaching a small vibrator to the back of the hand and blocking visual feedback from finger/hand mobility by blindfolding the subject (Rincover, et. al., 1979). Pairing blackout with stereotypic behaviors has also been used effectively to treat visual sensory feedback from finger/hand stereotypies (Rice & Lloyd, 1982; Rincover, et. al., 1979).

The sensory extinction approach has several advantages over other procedures in the sense that the reinforcer is immediately identifiable, is more natural than other techniques, interrupts existing contingencies rather than establishing new ones, and involves no aversive components (LaGraw & Repp, 1984).

Physical Restraint

Restraint is a response prevention technique designed to prevent the individual from engaging in stereotypic behavior. This procedure, which varies from simple hand restraint to use of strait jackets, is most commonly used for treating self-injurious behaviors in the institutionalized population.
Restraints have included use of padded chairs (Hamilton, et. al., 1967), strait jackets (Giles & Wolf, 1966), splints (Corbett, 1975), and mittens tied to wheelchairs or pants (Corbett, 1975; Hamilton, et al., 1967). Padding and shielding, which does not prevent the behavior but protects the individual from its consequences, have also been used (Dorsey, Iwata, Reid, & Davis, 1982). Examples include padded helmets to prevent head injury and layers of socks applied to the arms to prevent injury from biting or pinching. Use of air splints worn on the arms to prevent finger sucking but not normal range of motion have also been found to be effective in reducing stereotypic responding while permitting application of DRO (Ball, Campbell, & Barkemeyer, 1980). Sensory extinction procedures involving padding of body parts such as placing hands in foam gloves (Rincover, 1978; Rincover, et. al. 1979) have served the same function.

The effectiveness of restraint, however, has been demonstrated in only a few studies (Bitgood, Crowley, Suarez, & Peters, 1980). Therapeutic use of restraints has been applied as both a consequence (Favell, et. al., 1978; Hamilton, et. al., 1967; Rapoff, et. al., 1980) and antecedent (Parrish, Aguerrivere, Dorsey, & Iwata, 1980; Rojahn, Mulick, McCoy & Schroeder, 1978) to target behaviors as well as a punisher (Hamilton, et al., 1967;
Rapoff, et al., 1980) and reinforcer (Favell, et al., 1978; 1981). Response contingent restraint has also been applied successfully in conjunction with other techniques (Hamilton, et. al., 1967; Luiselli, Helfen, Pemberton, Colozzi, & Donnellon, 1979; Marholin & Townsend, 1978; Schroeder, Peterson, Solomon, & Artley, 1977).

Self-injury has been effectively reduced using "adaptive" jackets with large pockets designed to allow "self restraint" (Rojahn, et al., 1978) and with contingent use of a padded helmet (Parrish, et al., 1980). Contingent physical restraint has also been applied successfully to suppress head banging as time-out from positive reinforcement to suppress head banging (Hamilton, et. al., 1967; Williams, et al., 1978), as punishment for pica (Bucher, Reykdal, & Albin, 1976), and in combination with biofeedback relaxation training (Schroeder, et. al., 1977). Similarly, response contingent immobilization procedure consisting of briefly holding the subjects' hands by the side of the body or desk surface was found to be effective in reducing high rate hand stimulation in two children by Luiselli (1981).

Reid, Tombaugh and Vanden-Heuvel (1981), in examining the parameters of physical restraint in treating stereotypic body rocking found that this procedure was generally more effective when applied to the subject as he was bent over in the middle of the
behavioral sequence rather than when he was sitting up at the end of the sequence. In general, research with physical restraint has shown a 20 second physical restraint procedure to be as effective as restraint plus prompts, praise, and reinforcement with an autistic child (Luiselli, Helfen, Pemberton, and Reisman, 1977), a 3 minute restraint procedure to be as effective as 5 minutes in reducing "twiddling" of an autistic girl (Marholin & Townsend, 1978), and restraint in the form of manual guidance as effective as overcorrection for hands in mouth (Shapiro, Barrett, & Ollendick, 1980).

Singh, Dawson and Manning (1981) found that a 1 minute physical (jacket) restraint was effective in rapidly suppressing self-injury whereas the same procedures applied for 3 minutes resulted in an increase in self-injurious behavior. Differential effectiveness across subjects has also been reported (Bitgood, et. al., 1980). For instance, Bitgood, et al., (1980) found that, whereas restraint reduced target and collateral stereotypies in three retarded children, these behaviors increased in an autistic child.

Various problems have been reported with the use of restraints (Bucher & Lovaas, 1967; Lovaas & Simmons, 1969). Several investigators have noted that individuals seek restraint, suggesting that this procedure can serve as a positive reinforcer (Duker, 1975; Fevoll, et. al.,
Results from research by Higgenbottom and Chow (1975) suggest that, rather than restraint in and of itself, the degree and duration of restraint may be the significant factor involved in development of pathological stereotypies.

A second problem with restraint is that extreme restraint in and of itself can retard mental and social development (Rojahn, Schroeder, & Mulick, 1980; Schroeder, 1974) and can result in physical damage in the form of shortened tendons and atrophied muscles (Lovaas & Simmons, 1969). A third problem is that restraints do not necessarily eliminate stereotypies but prevent their occurrence so that once restraints are removed stereotypic behaviors reoccur (Bucher & Lovaas, 1968; Lane & Domrath, 1970). Finally, restraints restrict opportunities for engaging in adaptive behaviors by preventing the individual from engaging in appropriate activities (Picker, et. al., 1979). However, Williams (1974) demonstrated successful fading of a restraining device by using newspapers as splints and removing a few pages daily. Similarly, Cunningham and Peltz (1982) successfully employed parents in an vivo desensitization procedure characterized by extended periods without restraint to aid use of a helmet applied to prevent face slapping of a 10 year old retarded boy. Self-injury was
virtually eliminated and remained suppressed at 15 month follow-up.

**Faradic Punishment**

Electric shock is a noxious electrical stimulus delivered by a device (e.g., shock prod) to an individual's back or limbs for a brief time (generally less than 3 seconds) contingent upon the occurrence of stereotypic behavior (Butterfield, 1975). Aversive electrical stimulation is one of the most widely researched procedures and generally most effective procedure for suppressing stereotypic behaviors (Birnbaer, 1968; Bucher & Lovaas, 1968; Carr & Lovaas, 1982; Corte, et. al. 1971; Cunningham & Linscheid, 1976; Duker & Gathercole, 1976; Kohlenberg, 1970; Lovaas & Simmons, 1969; Luckey, Watson, & Musick, 1968; McFarlain, et. al., 1975; Merbaum, 1973; Prochaska, Smith, Marzilli, Colby, & Donovan, 1974; Tate & Baroff, 1966; Toister, Condren, Worley, & Arthur, 1975; Watkins, 1972; Whaley & Tough, 1970; White & Taylor, 1967; Young & Wincze, 1974. The only reported exception to the effectiveness of shock is with Lesch-Nyhan patients (Anderson, et. al., 1978; Anderson, et. al., 1975; Duker, 1975), whereas time out and differential reinforcement have been found to be effective in this population (Buzos, Ayllon, & Collins, 1981; Duker, 1975; Anderson, et. al., 1975). In their review of treatments for self-injury, Baumeister and
Rollings (1976) reported faradic punishment to be overall the most effective procedure for suppressing self-injury rapidly and completely.

Lovaas and his associates were among the first to demonstrate that brief, contingent, painful electrical shock was effective in rapidly suppressing self-injurious behaviors (Bucher & Lovaas, 1968; Lovaas, et al., 1965; Lovaas & Newsome, 1976; Lovaas & Simmons, 1969; Lovaas, Schaeffer, & Simmons, 1965; Prochaska, et al., 1974; Yeakel, Salisbury, Greer, & Marcus, 1970; Tate & Baroff, 1966). This procedure has been implemented for treating a number of different self-injurious behaviors including head banging (Lovaas & Simmons, 1969; McFarlain, et al., 1975; Tate & Baroff, 1966), ear and head pounding (Whaley & Tough, 1970), head hitting (Lovaas & Simmons, 1969), hitting hands on upper incisors (Simmons & Reed, 1969), face punching, eye poking and knee banging (Muttan, et al., 1975).

Advantages of shock treatment include ease of communication and understanding of the basic procedure, and it can be readily taught and utilized. In addition, when neutral stimuli are paired with shock they can become effective as a conditioned suppressor of stereotyped behaviors (Lovaas & Simmons, 1969; McFarlain, et al., 1975).
On the other hand, several considerations limit the practicality of this procedure. Several studies have shown that the suppressive effects of shock do not generalize beyond the treatment environment (Baumeister & Forehand, 1972; Lovaas & Simmons, 1969; Merbaum, 1973). Some variations have been revealed in the response to shock which might explain difficulties in generalization and increase in collateral behaviors. For instance, Kohlenberg (1970) noted that shock applied for severe vomiting in a 21 year old mentally retarded female resulted in an initial increase followed by a decrease in the target behavior. Miron and Alsup (1972) found that a child who initially reacted to shock by escape and avoidance behaviors, entered the laboratory setting, located the shock apparatus and presented it to the experimenter and then held out his arm, suggesting that this procedure may have acquired discriminative positive reinforcing effects. Young and Wincze (1974) found that electric shock was successful in reducing targeted head banging behavior in a profoundly retarded girl whereas head hitting which was not treated did not decrease, suggesting that shock may be response specific. Overall, evidence suggests that suppression effects of shock are situation and trainer specific and that generalization must be programmed (Miron & Rooney, 1973).
Because shock tends to suppress stereotypic behaviors only in the settings in which it is applied (Baumeister & Forehand, 1973; Birnbauer, 1968; Lovaas & Simmons, 1969), it has been recommended that this procedure be employed in all settings (Corte, et al., 1971). Attempts to promote generalization have generally focused upon reducing the discriminable properties of the treatment situation (Horner & Barton, 1980). Whaley and Tough (1968) utilized a device which automatically delivered shock each time the subject struck his face. Others have employed the aid of direct care staff in implementing aversive shock (McFarlain, et al., 1975; Tanner & Zeiler, 1975) or remote control devices (Duker, 1976; Prochaska, et al., 1974). A verbal warning has also been found to acquire at least temporary control after being paired with shock (McFarlain, et al., 1975; Lovaas & Simmons, 1969). Merbaum (1973) used a subject's mother at home and teachers at school as therapists. Other investigators (Callen, et al., 1969; Hall, et al., 1973) used several therapists and settings for treatment.

Another consideration involves inconsistencies found in the endurance of shock. Although generally durable, periodic reapplications of this procedure may be required to maintain suppression (Lovaas & Simmons, 1969; Rechter & Vrabic, 1964). Results suggest that it is imperative that shock be delivered immediately and contingently on
each occurrence of self-injury for a total suppression to occur (Whitman, Scibak, & Reid, 1983). Although this is not always possible to achieve procedurally, this problem has been alleviated with the use of portable remote or radio controlled shock devices (Duker, 1975a, Yeakel, et. al., 1970; Prochaska, et al., 1974).

Other investigators have found a dramatic recovery of target behaviors following treatment (Birnbauer, 1968). Jones, et al., (1974) reported not only ineffective results with the use of shock in treating self-injury but the appearance of other self-injurious behaviors, whereas extinction was found to be more effective. Mutter, Peck, Whitlow, and Fraser (1975) effectively treated the self-injurious behavior of a 10 year old female with shock following unsuccessful results with time out and pharmacotherapy procedures. However, this procedure, which was similar to that used by Lovaas and his associates (Lovaas, et. al.; 1965) took two 20 minute sessions per day over a three month period to suppress the target behavior. Callis, Carr, Corbett, and Jenkins (1973) also found that long exposure to electric shock spanning over six months was necessary for reducing self-injury. Similarly, Romanczyk and Goren (1975) found that a shock-DRO package was effective in reducing self-injury only after 109 months of treatment.
and over 1000 hours of implementation.

Another consideration in using shock procedures involves the negative effects associated with shock treatment including possible physical damage (Picker, et al., 1979) and undesirable behaviors (Prachoska, et al., 1974) in the form of aggression (Mayhew & Harris, 1978), avoidance, and pacificity (Simmons & Lovaas, 1969). However, Lovaas and Simmons (1969) reported positive side effects in the form of increased attending and decrease in whining following shock treatment for head banging and face slapping. Positive side effects have been reported in other studies as well (Merbaum, 1973; Wright 1973).

In their review, Lichstein and Schreibman (1976) indicated that the majority of side effects reported were positive and suggested that the incidence of negative side effects was not significant enough to preclude its use.

A final consideration for evaluating the practicality of faradic punishment involves ethical and legal issues. Shock is considered an extremely restrictive procedure which is painful, intrusive and susceptible to abuse in that it can be applied nontherapeutically and unethically (AABT Task Force, 1982). Use of electric shock with stereotyped behavior that does not inflict physical harm has been questioned by some professionals on ethical grounds (Hobbs &
Goswick, 1977). Tate and Baroff (1966) raised the question of potential abuse of this procedure following their finding that staff tended to use the buzz of the shock producer to coerce a subject to drink. One must weigh the benefits of shock against the risks of subjecting individuals to pain. Specifically, shock stimulation must be reserved for use in very extreme cases, devised and supervised by qualified behavioral experts, and implemented in settings which provide the highest standards of professional expertise and responsibilities toward human rights. The availability of less intrusive or painful procedures which have also been found to be effective, generally preclude global use of shock treatment. As a result of these serious considerations certain legal restrictions have been placed upon the use of shock as a punishment procedure (Wyatt vs. Stickney, 1974).

Because of the legal and ethical restraints placed upon this procedure researchers are reluctant to investigate the parameters of the shock strategy. For clinicians considering shock as a treatment, the research literature provides little information (Whitman, et al., 1983). Unfortunately, many of the available studies performed are limited methodologically, making interpretations difficult. Singh (1981) reported that only 7 of 20 studies reviewed employed methodologically
adequate experimental controls necessary for evaluative purposes and a comparable number of studies were lacking reliability data, generalization, and follow-up.

**Other Punishment Procedures**

A number of other aversive procedures have been applied contingently to treat stereotypic behaviors including hydrotherapy (Dorsey, Iwata, Ong, & McSween, 1980; Morwin & Kornegay, 1977; Murphy et al., 1979; Peterson & Peterson, 1977), visual screening (Lutzker, 1978; Singh, 1980; Singh, Beale, & Dawson, 1981; Zegiob, Alford, & House, 1978), aromatic ammonia held briefly under the nose (Altman, Hoavis, & Cook, 1978; Baumeister & Baumeister, 1978, Tanner & Zeiler 1975), bitter substance squirted in the mouth (Sajway, Libet, & Agras, 1974), contingent slapping (Duker, 1975; Koegel & Covert, 1972; Koegel, et. al., 1972; loud noises (Sajway & Hedges, 1971), and aversive music (Greene Hoats, & Hornick, 1970; Greenwald, 1978). Contingent hair tug (Banks & Locke, 1966; Griffin, Locke, & Landers, 1975), verbal reprimand in the form of "No" (Peine, 1972), and aversive tickling (Greene & Hoats, 1971), have also been employed but have produced only slight transitory reductions.

Only one study (Bates & Smeltzer, 1982) reported use of electroconvulsive therapy resulting in a successful response reduction without apparent aversive
consequences. Rage reduction, which involves placing the child upon the trainer's lap and prompting him/her to hit the trainer's hand rather than engaging in self-injurious behavior has also been used to suppress head slapping in a 10 year old psychotic child (Saposnick & Watson, 1974). Other procedures used to treat stereotypic behaviors include contingent alarm plus response prevention which were found to be effective in treating nocturnal head banging and body rocking in a 13 year old male of average intelligence (Lindsay, Salkovskis, & Stoll, 1982) and social contracting which was successful in eliminating nocturnal head banging in a 16 year old male.

*Water Mist.* Water mist or hydrotherapy (Peterson & Peterson, 1977) involves contingent spraying of a small amount of water in the subject's face. This procedure, first utilized by Peterson and Peterson (1968) was found to be successful in substantially reducing the self-injurious behavior of a severely retarded boy. Overall, the current research indicates that this procedure is effective in suppressing a variety of topographically different stereotypic behaviors, including self-choking (Murphy, et al., 1977), hand biting, skin tearing, and head banging (Dorsey, et al., 1982). No studies to date have shown total suppression of target behaviors with this technique and questions remain regarding the important parameters of this procedure. For instance,
Kerwin and Kornegay (1977), who attained reduction of self injury and maintenance at near zero rates, provided evidence to suggest that applying water mist 15-20 times contingent upon occurrence of the targeted behavior may be more effective than a single application.

**Visual Screening.** Visual screening is a mildly aversive procedure which has also been employed to reduce a variety of stereotypic behaviors including thumb biting (Singh, 1980), and head and face slapping (Lutzker, 1978). This procedure, which involves covering the subject's eyes either with a bib (Lutzker, 1978; Singh, 1980), eyescreen (Rincover, 1978) or therapist's hand (Barrett & Staub, 1983; McGonigle, Duncan, Cordisco, & Barrett, 1982), has also been found effective in treating both topographically similar and dissimilar stereotypic behaviors (McGonigle, et al., 1982). Visual screening has also been found to be effective in the treatment of compulsive rituals in the form of stereotypic shoe related behaviors (Barrett & Staub, 1983). There is some evidence (Zegiob, Alford, & House, 1978), to suggest that visual screening is not only effective in suppressing multiple self-injurious behaviors but the suppressive effects can be generalized to untreated self-injurious and disruptive behaviors.

Although visual screening has been assessed in only a few studies, recent research has focused on examination
of the parameters of this procedure. For instance, visual blocking was found to be a necessary component of the facial screening procedure in one recent study (Singh, Dawson, & Manning, 1981). In another study a one-minute duration was found to be most effective in immediate response reduction and short term generalization of treatment effects in comparison to durations of 3 seconds and 3 minutes (Singh, Beale, & Dawson, 1981).

**Aromatic Ammonia/Bitter Substances.** The effectiveness of aromatic ammonia in rapidly and totally suppressing stereotypic behaviors has been reported in several studies (Altman, et al., 1978; Baumeister & Baumeister, 1978; Singh, et al., 1981; However, Jones and Anderson (1981) found that ammonia was not as easy or effective in suppressing stereotypic acts and that potential side effects were also a problem. In addition, it has been noted that this procedure is potentially hazardous, not ideal for institutional settings (Baumeister & Baumeister, 1978), and that different durations of application may be necessary for different individuals (Altman, et al., 1978).

Bitter substances applied contingent upon stereotypic behaviors have included tobasco sauce applied to suppress rumination (Murray, Keale, & McCarger, 1977),
and lemon juice to suppress rumination (Sajway, et al., 1974) and finger knawing (Gross, Wright, & Drabman, 1980). Lemon juice in combination with introduction of toys for appropriate play has also been found to be effective in reducing face punching and head banging (Mayhew & Harris, 1979). However, complications have been reported with the use of bitter substances including irritation of external and internal areas of the mouth and aspiration into the lungs (Singh, 1981).

**Setting Events**

Most of the procedures described so far were primarily based on the manipulation of consequent stimuli. Altering stimulus conditions has not been the focus of applied behavioral research. An important stimulus concept in this regard is the setting event, defined as the environmental context in which a stimulus-response interaction occurs, and which influences the stimulus-response function (Bijou & Baer, 1978). The physical environment, the social context, or current physiological conditions of the organism can all be conceptualized as setting events. An example of the relevance of environmental setting events was presented by Solnick, Rincover, & Peterson (1977). They found that the effectiveness of a time-out program for self-injurious behavior and spitting in a 16 year old severely retarded boy with Down's Syndrome was related to the
environmental conditions of the treatment setting. Time-out was initially effective in an "enriched" setting only, in which new toys and rewarding social interaction were provided.

**Environmental Correlates Associated with Increase in Stereotypy**

**Noise Level.** Augmented level has been shown to increase stereotypic responding in a number of studies. Levitt and Kaufman (1965), found a positive correlation between rates of body rocking and four levels of ambient noise (51, 70, 85, 100, dB). Similarly, Forehand and Baumeister (1970) found that white (84dB) and varied noises (music, voices, banging sounds) significantly increased rates of body rocking relative to baseline conditions in severely retarded institutionalized subjects. Hollis (1968a) also found that a high noise level (95dB) increased rates of body rocking in retarded subjects. According to Maris (1971), it is the average length or likelihood of occurrence rather than the momentary rate of behaviors, once in progress, which are affected by noise.

**Stimulus Restriction/Deprivation.** Reports in the literature document an association between stereotypic behaviors and restricted environmental rearing, confinement, and maternal deprivation. Stereotypies from restricted environments have been reported in children.
raised in almost total isolation (Davis, 1940; 1946; Freedman & Brown, 1968), confined to cribs (Levy, 1944; Warren & Burns, 1970), deprived of toys due to disease (e.g., measles), or danger of infection, and in infants frequently confined to infant seats, playpens, or high chairs (Thelen, 1980). Warren and Burns (1970) reported that crib confinement was found to be a more crucial component associated with the occurrence of stereotypic behaviors in profoundly retarded children than availability of toys.

Kaufman and Levitt (1965) suggested that food deprivation was associated with increased stereotypy on the basis of their finding that body rocking in institutionalized retarded individuals was low immediately after breakfast and increased just prior to lunch. Although this finding might be considered indirect support for the deprivation hypothesis, a similar increase was not found to occur prior to dinner.

A few studies have addressed the aspect of number of individuals present in comparing setting complexity to stereotypic behaviors. Tierney, McGuire and Walton (1979) reported a significant positive correlation between number of stereotypies of institutionalized severely retarded individuals and three conditions; number of residents present, number of residents present who engaged in stereotypic behaviors, and number of
stereotypies engaged in by residents on the ward. Barton and Repp (1981) found that increasing the population density in an institutional setting when only one staff member was present resulted in an increase in stereotypic responding in retarded individuals whereas increasing population density when two or more staff members were present resulted in no change in rates of stereotypy. Similarly, Baumeister and Forehand (1970) found increased stereotypic responding in 12 institutionalized persons when moved from isolation to groups of four. Forehand and Baumeister (1971) reported that the environmental effect of stereotypies is in part related to the individual's IQ. Results of their study showed that rates of body rocking in high IQ (20-30) institutionalized retarded individuals was greater in a restricted setting as opposed to the ward, whereas the average rate of the low IQ group was not found to be dependent upon location.

Assumptions about the apparent relationship between increased stereotypies and confinement are difficult to make due to inadequate specification of independent variables. For example, variables such as restraint, confinement, spatial density, social accessibility and visual access are frequently confounded or inadequately defined (Berkson, Mason, & Saxon, 1963; Levy, 1944). Such difficulties have plagued a number of studies (Levy,
leading to the observation that various etiologies might account for stereotypic responding such as motor restraint and sensory motor deprivation, or that different response classes may have different origins and/or different functions (Lewis & Baumeister, 1983).

Environmental Correlates Associated with Decrease in Stereotypy

Sensory Stimulation. An enriched environment and sensory stimulation have been found to produce a reduction in stereotypic responding. In studying the effects of visual and auditory stimuli on the stereotypic behavior of a 38 year old profoundly retarded female, Bornstein and Smith (1976) noted that a blinking light significantly decreased stereotypy in a darkened room, whereas music had no effect. Stevens (1966) provided data showing significant changes in speeds of rocking behavior of twelve severely and profoundly retarded subjects through environmental manipulation of musical tempo. Consistent with research on body rhythm (see Berkson, 1983) and research which has shown an increase in stereotypy in association with noise level, Adams, Tallon and Stangle (1980) found significantly lower levels of stereotypy under quiet and music conditions in comparison to a condition in which subjects were exposed to television programs. Forehand and Baumeister (1970)
found a significant reduction in body rocking in association with presentation of white light or colored pictures/objects with the greatest reduction occurring during presentation of colored pictures. However, in a direct replication of the Forehand and Baumeister study, Maris (1971) was unable to show a reduction in rocking under conditions of enhanced stimulation.

**Object Manipulation.** A more consistent finding is that stereotypic behaviors tend to decrease when the subject is given the opportunity to engage in alternate activities which require some form of motoric manipulation. In one of the first investigations directed toward assessing this hypothesis, Davenport and Berkson (1963) found that presentation of objects by the experimenter resulted in significant reduction in stereotypy of severely retarded individuals. Landau (1981) also found an inverse relationship between degree of object manipulation and stereotypic movements in infants. These findings confirmed those of by Guess and Rutherford (1967) who found that blind retarded individuals showed less stereotypy when presented objects to manipulate, and are consistent with Levy's (1944) observation that children who displayed stereotyped behaviors when deprived of toys, ceased stereotypy when toys were provided. Other researchers have also found that increasing toy play was an effective means of
reducing self-injury (Favell, 1973; Mulick, et. al., 1978).

Accessibility of manipulatable objects has also been found to reduce stereotypies elicited in restricted environments. For example, Warren and Burns (1970) found that presentation of toys would reduce stereotypic behavior of crib-confined retarded individuals. Lockwood and Bourland (1982) reported that self-injurious behaviors in two nonambulatory profoundly retarded persons were reduced when toys were presented, but when toys were more accessible through attachment to the wheelchair self-injury decreased by half.

Reinforced object manipulation has also been found to be effective in reducing stereotypic responding. Hollis (1968) found that reinforced ball pulling eliminated stereotypic body rocking whereas stereotypy returned to its original rate under an extinction condition. Lovaas, Freitag, Gold, and Kassorla (1965), also reported a reduction in stereotyped head banging in an autistic child following reinforcement (praise) of an alternate activity.

The effects of different types of objects on stereotypic behaviors were assessed by Watters and Wood (1983) who found increased stereotypy when a soft toy was presented in comparison to hard and wheeled toys in 7 autistic and mentally retarded boys suggesting that
stereotypies are influenced by the nature of the objects themselves. In a different vein, Berkson and Mason (1964) found a higher level of object manipulation and lower level of stereotypic movement in subjects whose most frequent stereotyped act was rocking or swaying in comparison to a group of subjects who engaged in hand movements and postures suggesting that stereotypies may not represent a homogeneous class of behaviors but may be maintained by different situations or circumstances and may differ in terms of functional significance (Baumeister & Forehand, 1973).

**Social Environmental Conditions.** Hutt and colleagues (Hutt & Hutt, 1965; Hutt, Hutt, Lee and Ounstead, 1965) found that increased environmental complexity and opportunity for social interaction lead to increased stereotypy in autistic children. On the other hand, Baumeister, MacLean, Kelly, and Kasari (1980) found that stereotypic behaviors were less frequent among preschoolers in situations where the subjects were actively participating in an activity (e.g., art, mealt ime) while the highest rates occurred during music class.

In two studies performed to test effects of situational variables on stereotypic behaviors of profoundly retarded adults, Berkson and Mason (1963) found that these behaviors increased in a novel,
restricted environment and decreased in a familiar situation which provided opportunity to engage in alternate activities (i.e., locomotion and object manipulation). In a more recent series of studies the same researchers (Berkson and Mason; 1984b) found that handing objects to subjects while talking to them resulted in lower level of stereotypy and increased level of object manipulation relative to a control condition. Similarly, Mosely, Faust, & Reardon (1970) reported a significant reduction in stereotypic responding during a "social" as compared to the "objects only" condition.

Several problems are inherent in making assumptions about these findings relative to social and environmental conditions since "sensory" and "social" variables are difficult to define and not well controlled for. In a more direct approach, Bittle and Hoke (1977) found that assigning tasks and instructing an autistic child not to engage in stereotypies was effective in reducing stereotypic responding particularly in a classroom setting over either a large room, a small room and play room respectively.

Interaction of Behavior Modification and Medication

It has been widely recognized that the interaction of behavior modification and psychoactive drugs may be a promising therapeutic synthesis for different clinical populations and problems (Hersen, 1986; Marks, 1982;
Schroeder, Lewis, & Lipton, 1983). In fact, behavior modification techniques and pharmacotherapy have been frequently used in clinical practice with the mentally retarded population. Radinsky (1984), for instance, reported that 38% of the retarded persons receiving psychotropic drugs were simultaneously treated in part with behavior modification programs for some maladaptive behaviors. Considering this extensive use of conjoint behavioral and pharmacological treatments, much too little clinical research efforts have been invested in this area (Sprague & Baxley, 1978).

The effects of a combination of haloperidol (of the butyrophenone class) treatment and a mild punishment technique (arm squeeze contingent upon self-hitting) was compared to each of these treatment modalities alone for self-injury in a profoundly retarded adult, over a 12 month period of time (Durand, 1982). This procedure involved a withdrawal design with single-blind conditions (therapists and reliability observers were blind towards drug manipulations), but no placebo control. The data suggested that neither the medication nor the behavioral intervention alone effectively reduced self-injury, whereas the combination of the two treatment modalities turned out to be highly effective. Durand (1982) also reported greater success with a behavioral/pharmaco-
therapy treatment package using haloperidol than either pharmacotherapy or behavior therapy alone.
III Methodology

Methods of Procedure

Subjects.

The participants in this study were mentally retarded children (as defined by AAMD criterion) with behavioral disorders (as measured by the AAMD Adaptive Behavior Scale and the Aberrant Behavior Checklist) and having a primary psychiatric diagnosis (based on DSM III criteria served by the John Merck Program for Multiply Disabled Children, Western Psychiatric Institute and Clinic University of Pittsburgh School of Medicine. Inclusion criteria involved subjects who had a chronic history (i.e., at least 3-6 months duration) of stereotypic behaviors (self-injury and/or self-stimulation) upon referral to inpatient hospitalization and in which these behaviors were maintained at high rates (60-70% of time sampling intervals over baseline period following admission).

For the purpose of this study mental retardation was defined as significant subaverage general intellectual functioning existing with concurrent deficits in adaptive behavior and manifested during the developmental period (Grossman, 1977). Psychiatric diagnoses referred to major psychiatric categories of behaviors of childhood and adolescence (Diagnostic and Statistical Manual of
Behavior disorders referred to any intrapunitive or extrapunitive behavior manifested above the 80th percentile as measured by Part II of the Adaptive Behavior Scale (Nihira, Foster, Shellhaas & Leland, 1974) and any category of behavior 1.5 times above the mean number for that category as measured by the Abberant Behavior Checklist (Aman & Singh, 1983). (See Appendix A)

A total of six (6) children were assessed in this study. Subject characteristics are as follows.

Subject 1 was an 8 year 1 month old white male with diagnoses of infantile autism, and severe mental retardation (mental age=22 months). The primary referral concerns for this subject upon admission to inpatient hospitalization were noncompliance, aggression, disruption (e.g. throwing objects, tantrums, loud vocalizations), stereotypic behaviors of various sensory modalities (e.g. auditory, tactile, visual, and oral), self-injury, enuresis and encopesis. The target stereotypic behaviors for subject 1 included mouthing (e.g. placing hands/objects in mouth, drumming fingers across lips) and self-biting. Collateral stereotypies included hand flapping and finger flicking. Subject 1 was medication free during the experimental phase of this study. However, at discharge the patient was on Haldol
.5 mg at 8 a.m. and 1 mg. at 8 p.m. with Cogentin 1 mg.
BID/PRN.

Subject 2 was a 3 year 6 month old white male with
diagnoses of infantile autism and moderate mental
retardation (mental age=24 months). The primary referral
concerns for this subject upon admission to inpatient
hospitalization included noncompliance, tantrums, self-
injury, and stereotypic behaviors. Targeted stereotypies
for subject 2 included mouthing (e.g. placing hands and
objects in mouth) and self-biting (including flicking the
thumb off the roof of the mouth and teeth). Collateral
stereotypies for this subject included hand
posturing/waving and nose rubbing. Data on subject 2 were
collected following stabilization of medication (Tegretal
150 mg. tid.) for complex partial motor seizure disorder.

Subject 3 was a 10 year 7 month old white male with
diagnoses of atypical mixed organic brain syndrome,
profound mental retardation, (mental age= 10 months) and
seizure disorder. Primary referral concerns for this
subject upon admission to inpatient hospitalization
included noncompliance, sleep disturbance, enuresis,
encopresis, aggression, stereotypic behaviors, and severe
self-injury in the form of head banging, self-scratching,
and self-biting, requiring physical and mechanical (e.g.
helmet) restraints. This patient entered the hospital
with eyes blackened by head banging, numerous bruises,

Upon admission subject 3 was receiving medication in the form of Mebaral (32 mg. q.a.m. and 64 mg. q.h.s.), thorazine (10 mg. t.i.d.), and benadryl (25 mg. q.h.s.). Data were collected following withdrawal of these medications and stabilization of Tegretal (1100 mg. p.o. q.i.d.) for seizure control. At the time of discharge subject 3 was also placed on Antabuse 25 mg. p.o. q.d. instituted as a mechanism to increase blood level of Tegretol by slowing liver metabolism.

Subject 4 was an 8 year 15 month old white male with diagnoses of infantile autism and severe mental retardation (mental age=16 months). Primary referral concerns for this subject upon admission to inpatient hospitalization included self-injury (e.g. head banging, arm/eye poking, self-biting, self-scratching/picking), sleep disturbance, enuresis, encopresis, coprophagia, fecal smearing, stripping, and stereotypic behaviors of various sensory modalities (e.g. oral, auditory, tactile, olfactory). The target behaviors for subject 4 included mouthing (e.g. placing hands in mouth, lip stroking) and self-injury (e.g. self-biting, body poking/scratching/picking). Collateral stereotypic
behaviors included tactile and olfactory stimulation as well as flicking of objects. Subject 4 was on no medication during the course of hospitalization.

Subject 5 was an 11 year 9 month old white male with diagnoses of atypical organic brain syndrome, pervasive developmental disorder and profound mental retardation (mental age=7 months). Primary referral concerns for this patient upon admission to inpatient hospitalization included noncompliance, aggression, disruption (e.g. tantrums, throwing objects) enuresis, encopresis fecal smearing, stereotypic behaviors and self-injury. Target stereotypic behaviors for subject 5 included mouthing/thumb sucking, and self-biting. Collateral stereotypies included tactile stimulation (e.g. rubbing fingers across face, arms and through hair) and arm posturing/flailing.

During the course of hospitalization, subject 5 was placed on a trial of Dilantin for seizure control which resulted in physical (e.g. lethargy) and behavioral (e.g. increase in target behaviors) side effects. Therefore this medication was replaced by Depakene. Data were collected following stabilization of Depakene at 125 mg. q. 8 a.m., 12 p.m., 4 p.m. and 250 mg. p.o. q. 8 a.m. This medication was discontinued following discharge from hospitalization.
Subject 6 was a 12 year 2 month old white male with diagnoses of mixed organic brain syndrome, profound mental retardation (mental age= 5-11 months), and partial complex seizure disorder. Primary referral concerns for this subject upon admission to inpatient hospitalization included rumination, stereotypic behaviors (e.g. body rocking, finger motility, mouthing, extending lower lip and blowing air across face into hair), and severe self-injury in the form of self-biting (of hands, arms, legs), requiring medical attention for open wounds on several occasions. This patient entered the hospital with arms wrapped in gauze and covered with long tube socks. However, the patient was able to bite through these wrappings and the patient was fitted with straight arm splints at night and flexion splints for daytime. In addition to the self-biting, subject 6 exhibited self-pinching and self-scratching resulting in callouses which formed on the inner surfaces of the thumbs and the lateral aspects of fingers bilaterally. Targeted behaviors for subject 6 included mouthing and self-biting. Collateral stereotypies included finger motility. Data were collected on subject 6 with splints removed following stabilization on Dilantin (75 mg. p.o. 8 a.m., 1 p.m. and 100 mg. p.o. q. 8 p.m.) for seizure control.
Setting and Staffing:

The John Merck Program which occupies the sixth floor of the Western Psychiatric Institute & Clinic, a Psychiatric Hospital, contains living space for children and office space for staff. A full professional and direct service staff are employed on the program. The professional multidisciplinary staff includes a total of 20 full time positions including psychologists, child psychiatrists, pediatrician, social workers, special education teachers, a licensed physical therapist, and a certified speech pathologist. The unit also serves as a rotation for pre- and post-doctoral psychology students, psychiatry residents, and student volunteers. Direct care to children is provided by 36 full time direct care staff consisting of nursing and child care disciplines.

The John Merck Program offers residential programming for MH/MR children 3-20 years of age who exhibit severe behavior and/or physical problems. The unit census generally includes 22-24 patients at any given time. Approximately 90-100 children are admitted annually with a mean length of hospitalization from 60-90 days. Records over a one year period (1983-1984) revealed that approximately 70% of the children admitted to the John Merck Program exhibited some form of stereotypic behavior. Of these, 9% exhibited self-injurious behavior alone, 30% exhibited self-stimulatory
behaviors alone, and 61% exhibited both self-injurious and self-stimulatory behaviors.

Experimental Design

Treatment Schedule

An alternating treatment design (Barlow & Hayes, 1979; Kazdin, 1982; Shapiro & Barrett, 1982) was employed in this study. There are three phases to the alternating treatment design: (a) a baseline phase (A) in which target behaviors (dependent variables) are observed across several conditions followed by (b) a treatment phase (B) in which two or more treatment conditions (independent variables) along with a no-treatment baseline condition are alternately implemented in a counterbalanced fashion across time periods, and (c) the final phase (B') where the most effective treatment from the previous phase is implemented across all conditions (see Shapiro & Barrett, 1982). In this study a fourth category (C) was used to represent the inclusion of the DRI component along with the alternating treatment phase (i.e., BC) and/or best treatment phase (i.e., B'C). A no treatment condition (A') was included after each treatment phase to control for treatment effects. Two (2) children (subjects 2 and 5) served in a group to assess DRI alone and then with the alternating treatments of VS (Visual Screening) and Overcorrection. Two (2) children (subjects 3 and 4) served in a group designed to
assess alternating treatments (VS and Overcorrection) alone and then in combination with DRI. Two (2) children (subjects 1 and 6) served in a group designed to assess the combination of DRI and the alternating treatments (VS and Overcorrection). Following these phases, all children were treated unitwide with the treatment determined to be most effective on an individual basis within the laboratory treatment session.

The dependent variables for this study were stereotypic behaviors including both self-injury (e.g., self-biting) and self-stimulation (e.g., mouthing). Other dependent variables included both negative and positive collateral behaviors. Negative behaviors included disruption (e.g., all physical striking/hitting, kicking, biting, pinching, pushing of others, crying, screaming, loud vocalizations, and throwing/destroying objects, noncompliance [e.g. failure to respond to directives within two verbal prompts]), and collateral stereotypies (see subject descriptions above). Positive (adaptive) behaviors included in-seat and on-task behaviors (defined as at least 8 of the 10 second time sampling interval spent looking at and/or manipulating tasks in a goal directed manner). Inter-individual variability and generalization to other individuals was addressed through replication of the same treatment protocol on 2 subjects across each condition.
Procedure

For all subjects a one week (5 sessions) baseline assessment (condition A) was carried out followed by a two week (10 sessions) implementation of one of three treatment conditions. For two subjects, condition B (phase 1) included a DRI procedure alone for two weeks followed by condition BC (phase 2) which included DRI in combination with alternating treatments (VS and Overcorrection) for two weeks. For two subjects, condition B (phase 1) included alternating treatments (VS and Overcorrection) followed by condition BC (phase 2) which included alternating treatments in combination with DRI for two weeks. For two subjects, there was no B condition but subjects were begun on a BC condition (across both phases 1 and 2) consisting of the combination DRI/alternating treatment phase. For all six subjects, the BC condition was followed by the B' (C) condition which represented the treatment of choice for each individual subject. A no treatment phase (A') was also implemented for all subjects following each treatment phase and prior to implementation of the best treatments. Simultaneous with these treatment conditions within the laboratory setting, baseline probes were taken on target behaviors while subjects were engaged in structured activities within the structured Learning Center in order to evaluate generalization effects.
Following fulfillment of these treatment requirements, the best treatment(s) were then implemented unitwide for all subjects. Follow-up data were collected at six weeks on all subjects following discharge from hospitalization. The three experimental groups and order of treatment procedures are outlined in Appendix B.

**Laboratory Sessions**

For each subject, three 15 minute sessions were scheduled at the same time daily for 5 days per week during which time he was involved in laboratory sessions where behavioral treatment effectiveness was assessed. One small treatment room furnished with table and chairs was used to assess laboratory performance. Both the laboratory setting and Learning Center were equipped with Plexiglas one-way observation windows to facilitate unobtrusive visual and auditory observation/recording. During each session, subjects were instructed to work on 3 visual motor tasks appropriate for his mental age level. Condition-specific nonverbal (e.g. auditory and visual) cues were provided immediately preceding each treatment condition to provide discrimination to the subject on the appropriate condition which was in effect. During the baseline phase, all children were verbally prompted to use the materials but no reinforcement was provided. Both task presentation and treatments were counterbalanced across sessions (see Table 1).
TABLE 1  
COUNTERBALANCE SCHEDULE OF ALTERNATING TREATMENTS

Conditions:  
A = Visual Screening  
B = No Treatment  
C = Overcorrection

<table>
<thead>
<tr>
<th>SESSION</th>
<th>CONDITION</th>
<th>TASKS</th>
<th>SESSION</th>
<th>CONDITION</th>
<th>TASKS</th>
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<td>213</td>
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<td>CBA</td>
<td>312</td>
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<tr>
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<td>CBA</td>
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<td>23</td>
<td>BCA</td>
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<tr>
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<td>CBA</td>
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Behavioral interventions consisted of a verbal warning (e.g., "No mouthing," "No biting") followed by implementation of either visual screening or overcorrection for 10 seconds duration. The length and form of both punishment procedures were derived from those typically used on a clinical basis on the unit. Visual screening involved manually covering the subject's eyes with one of the therapist's hands to compromise all visual input. Positive practice Overcorrection involved manually guiding the subject through appropriate manipulation of task materials for 10 seconds by the therapist. DRI involved reinforcement (in the form of physical contact, praise and attention) of incompatible behaviors on a 10 second fixed interval schedule for one week followed by a variable interval 10 second schedule. The form of reinforcement (e.g. praise/attention and physical contact) was derived from an attempt to keep all reinforcement consistent across subjects. Therapists for this study included master level professional staff (i.e., developmental specialist or psychologist) trained in the implementation of behavior management procedures.

Data Collection and Apparatus

Ongoing behavioral observations by trained undergraduate psychology and special education students provided data on the dependent variables. Observers were trained extensively by the principal investigator in the
use of the observation system and identification of target behaviors using both videotapes and direct observation of stereotypic behaviors of patients through in vivo practice sessions. Although subjects 2, 3, 5, and 6 were diagnosed as having seizure disorders, stereotypies were differentiated from the behavioral manifestation of seizures so that the data collected on both target and collateral stereotypies as defined in this study were distinguished from those of defined seizure activity.

Data were collected unobtrusively from an observation booth situated behind a one-way observation window in both the treatment room and the classrooms. A continuous 10 second interval recording device was used for data collection facilitated by a tape which was prepared to provide cues at 10 second intervals. A partial interval recording procedure (e.g. one or more occurrence of the target behavior within an interval except for on task behavior which referred to at least 8 seconds duration) was used by data collectors. (See sample data sheet Appendix C).

Interrater reliability was maintained throughout the study by a second observer who was present for at least one-third of the total number of observation sessions. Reliability was calculated using the standard percent agreement formula agreement/agreements plus disagreements
Observers were required to meet at least 80% interrater agreement prior to serving in this study. Percentage interrater agreement during reliability checks for each subject's behavior is outlined in Table 2.

**Consent Procedure**

Treatment procedures and consent forms were reviewed and approved by the Internal Review Boards (IRB) of the Ohio State University and University of Pittsburgh as well as the Research Committee of Western Psychiatric Institute and Clinic. Objectives, procedures, and a statement of risks and benefits of treatment were explained to the parents/guardians of the children in this study. Procedures were also explained to the children within the limits of their understanding. (see Appendix D).
<table>
<thead>
<tr>
<th>Lab</th>
<th>SUBJECT 1</th>
<th>SUBJECT 2</th>
<th>SUBJECT 3</th>
<th>SUBJECT 4</th>
<th>SUBJECT 5</th>
<th>SUBJECT 6</th>
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<tbody>
<tr>
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<td>93 (67-100)</td>
<td>85 (75-100)</td>
<td>85 (65-100)</td>
<td>95 (85-100)</td>
<td>92 (80-100)</td>
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<td>Mouthing</td>
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<td>94 (76-100)</td>
<td>97 (90-100)</td>
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<td>94 (82-100)</td>
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<td>98 (84-100)</td>
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<td>90 (67-100)</td>
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<td>98 (80-100)</td>
<td>88 (80-100)</td>
<td>96 (75-100)</td>
<td>97 (85-100)</td>
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<table>
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<th>Class</th>
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<th>SUBJECT 4</th>
<th>SUBJECT 5</th>
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<tr>
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<td>99 (96-100)</td>
<td>96 (85-100)</td>
<td>92 (65-100)</td>
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<td>Stereotypies</td>
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<td>86 (74-100)</td>
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<td>Oppositionalism</td>
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<td>94 (79-100)</td>
<td>95 (80-100)</td>
<td>91 (70-100)</td>
<td>98 (95-100)</td>
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</tr>
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</table>
IV Results

The hypotheses of this study explored the efficacy of two operant punishment procedures (Visual Screening and Overcorrection) in conjunction with a positive reinforcement procedure (DRI) in treating stereotypic (both self-stimulatory and self-injurious) behaviors. It should be noted that for most subjects a predominance of either one class of behavior was exhibited over the other. For subjects 1, 3, and 5, self-stimulation was the predominant response whereas for subjects 4 and 6 self-injury was the predominant response. Nevertheless, results from this study are based upon the behavioral responses for both classes of behavior. The results are as follows:

Question 1: Which of two punishment procedures (e.g., Visual Screening or Positive Practice Overcorrection) is more effective in treating stereotypic behaviors, both self-injury and self-stimulation?

For all subjects the Visual Screening Procedure proved more effective overall than Overcorrection in treating both classes of stereotypic responding, self-stimulation and self-injury. This was evidenced by the greater overall reduction in targeted behaviors (see Figures 1-6) across the sessions in which Visual Screening was implemented in comparison to those sessions
FIGURE 1

CONDITION 1 DRI/ALT TX
SUBJECT 2

CONDITION 1 DRI/ALT TX
SUBJECTS

LEGEND

DRI
OVERCONNECTED
VIRTUAL SCREENING
DRI & OVERCONNECTED
DRI & VIRTUAL SCREENING
NO TREATMENT
FIGURE 2
FIGURE

MOUTHING

FIGURE 5

CONDITION 3 ALT TX & DDI
SUBJECT 6
SESSIONS

LEVELS
○ OVERREACTIVITY
△ VERTICAL SCIENTIFIC
□ ostrich overreactivity
△ β vertical scientific
□ no treatment
○ best tx replaced in yr 8
in which Overcorrection was implemented.

Question 2: Is there a difference in the responsiveness of the two classes of stereotypic behaviors (e.g., self-injury, self-stimulation) to the two punishment procedures, (Visual Screening and Overcorrection) either alone or in combination with DRI?

Both classes of stereotypic behaviors responded better to the Visual Screening treatment procedure than the Overcorrection treatment procedures when these techniques were used both alone and in combination with DRI. (see Figures 1-6) These results are more noticeable for subject 3 than for subject 4 (see Figures 3 and 4) although both subjects exhibited considerable variability in their behavioral responses. Subject 3 showed more consistent responding to Visual Screening both alone and in combination with DRI. For subject 4, (Figure 4) the increase in self-biting across all treatment conditions with the introduction of DRI may be reflective of loss of behavioral control following return to baseline. This was not evidenced following the second return to baseline when the combination of Visual Screening and DRI were implemented consistently across all treatment sessions.
Question 3: Does the introduction of a DRI technique in combination with Visual Screening or Overcorrection enhance the effectiveness of one punishment technique over the other in terms of suppressing stereotypic behavior and increasing appropriate behavior?

The introduction of the DRI technique in combination with Visual Screening and Overcorrection did not enhance the effectiveness of one technique over the other in suppressing stereotypic behavior. (see Figures 3, and 4) For subject 3, however, DRI implemented alone was more effective than no treatment and DRI in combination with overcorrection was slightly more effective than overcorrection implemented alone. For subject 4 the loss of behavioral control following the return to baseline made it difficult to compare results from the introduction of DRI in phase 2 with the punishment techniques implemented alone in phase 1.

Results from the introduction of the DRI technique in combination with Visual Screening and Overcorrection for appropriate, on-task behavior (see Figure 7) are similar to those for stereotypic behaviors. That is, the effectiveness of one technique was not enhanced over the other with the introduction of DRI for this behavior. However, for both subjects 3 and 4, a slight increase in on-task behavior occurred with both treatment techniques
following the introduction of DRI in phase 1. For this behavior, as with the targeted stereotypic behavior of subject 3 the implementation of DRI alone was more effective than no treatment. Because of this influence evidenced by DRI both alone and in combination with the punishment procedures it was included as a component in the best treatment condition across the last phase of the study.

Question 4: Will the introduction of DRI following behavioral suppression result in more rapid and dramatic increases in adaptive responding in comparison to either the simultaneous implementation of DRI in combination with the punishment procedures or DRI alone?

The introduction of DRI in the second alternating treatment phase of condition 2 for subjects 3 and 4 (see Figure 7) did not result in a dramatic increase in adaptive responding in comparison to either the simultaneous implementation of DRI in combination with the punishment procedures for condition 3 of subjects 1 and 6 (see Figure 8) or DRI used alone in condition 1 for subjects 2 and 5. (see Figure 9) However, the converse condition involving the introduction of punishment procedures in phase 2 of condition 1 for subjects 2 and 5 following implementation of DRI alone in phase 1 resulted in a noticeable increase in adaptive responding,
particularly for subject 5.

Results from both subjects 2 and 5 point to a potential methodological flaw in the form of multiple treatment interference as evidenced by the noticeable approximation of behavioral responses across all treatment conditions in phase 2. This may be due to poor discrimination by the subjects across treatment conditions in phase 2 all of which included a treatment component (e.g. DRI) which was in effect during the previous phase.

It should also be noted that the on-task behavior of Subject 3 (Figure 7) increased within the classroom over time independent of treatment within this setting (e.g. during the no-treatment phase). These results may be indicative of learning effects. Nevertheless, the escalation in this behavior paralleled the change in laboratory treatment phases suggesting potential spontaneous generalization of treatment effectiveness.

Question 5: What is the effect, if any, of Visual Screening and Overcorrection on negative collateral disruptive behaviors (e.g., aggression, disruption)?

Overall, the results for disruption are inconclusive. The data for all subjects revealed no dramatic difference between the effects of Visual Screening and Overcorrection on negative collateral
Figure 10

Condition 3: Alt TX & Dem
Subject 6
Figure 12
behaviors in the form of oppositional-disruptive behaviors (e.g. aggressive-disruptive responding and noncompliance) (see Figures 10-12). However, Visual Screening was generally associated with less oppositional disruptive responding than the overcorrection and DRI procedures, particularly when this procedure was paired with DRI (see Figure 10, Subjects 1 and 6). Data on out-of-seat behavior for all subjects were zero rates across all sessions. Therefore results for this behavior were not graphed.

The effect of the various treatment procedures upon non-targeted stereotypies (see Figures 13-15) which were not treated was strikingly parallel to the results for the targeted stereotypic behaviors (e.g. mouthing and self-biting) (see Figures 1-6) which were treated. These behaviors also decreased overall during sessions in which the Visual Screening procedure was implemented.

Question 6: Will the effectiveness of either of the procedures generalize spontaneously beyond the treatment session or will they have to be programmed in other settings?

With the exception of subject 3 (see Figures 7 and 14) where a simultaneous reduction in stereotypies and increase in on-task behavior occurred over time without treatment, none of the effects of treatment generalized spontaneously to the classroom setting without
Figure 13
FIGURE 15
programming in that setting (see Figures 1-10). It should be noted, however, that the results following programmed generalization to the classroom setting were for the most part dramatic both in terms of behavioral reduction of inappropriate behaviors and increase in appropriate behaviors. Subjects 1, 4, and 5 showed a more dramatic response in increasing appropriate behaviors than subjects 2, 3, and 6. (see Figures 7-9). Subjects 1, 2, 3, and 4 showed a more dramatic reduction in targeted stereotypies than subjects 5 and 6. (see Figures 1-6).

Question 7: Will treatment effects be maintained over time (i.e., 6 weeks)?

For all subjects treatment effectiveness was maintained with continued program implementation in classroom settings following discharge from hospitalization as evidenced by the results at 6 week follow-up. (see Figures 1-15).

Statistical analysis of the data using a celeration line and calculating the results with a binomial test to determine the distribution of frequencies of data points for the different treatments was performed to further delineate treatment effectiveness. For subject 1, results were significant only for visual screening in treating self-injury (.001) and stereotypies (.011). Results were significant across all treatments for
mouthing (.001), whereas the data across all treatments for on-task and disruption were nonsignificant. For subject 2, the results were significant across all treatments for on-task (.001), self-injury (.001), disruption (.011), and stereotypies (.011), whereas the data for mouthing were nonsignificant across all treatments. For subjects 3, the results were significant only for visual screening for on-task (.001), mouthing (.001), and stereotypies (.001). The data were significant across all treatments for self-injury and disruption. For subject 4, the data were significant across all treatments for mouthing (.001), stereotypies, and on-task behavior. Results were significant for both visual screening (.001) and DRI (.011) for disruption and for visual screening alone (.011) for self-injury. For subject 5, the data were significant only for visual screening for mouthing (.001) and on-task behavior (.05). Results were significant across all treatments for stereotypies, and self-injury whereas the data for disruption were nonsignificant. For subject 6, results were significant only for visual screening for mouthing (.011) and on-task behavior (.001) whereas results for the other behaviors were nonsignificant.
Discussion

Data in the present study revealed that for all subjects a 10 second Visual Screening Procedure was more effective than a 10 second Overcorrection Procedure in reducing stereotypic behaviors, both self-stimulation (e.g. mouthing) and self-injury (e.g. self-biting) while increasing appropriate (on-task) behavior. Based upon behavioral observations and reports from therapists in this study, the Visual Screening Procedure was easier to implement than the Overcorrection Procedure. This ease of application may have contributed to the overall effectiveness of this technique. Ease of program implementation not only makes a procedure preferable among therapists but increases the likelihood that it will be used more consistently resulting in more rapid behavioral change.

It is possible that the length of program implementation in the present study was a factor in determining the differential effectiveness of the two punishment procedures compared. For instance, overcorrection implemented for durations of 2 (Holvoit, 1977), 3, and 5 minutes (Marholin & Townsend, 1978) were reportedly successful in suppressing stereotypies according to the available literature. However, it can be argued that a 10 second Visual Screening Procedure which is easier to implement and more effective at
shorter duration should be the treatment of choice in such cases. The conclusions drawn from these results are that the Visual Screening Procedure not only represents an effective technique for treatment of stereotypic behaviors but is easily implemented resulting in more immediate and consistent program implementation.

**Differential Treatment Effectiveness on Collateral Behaviors**

Whereas previous reports have shown behavioral side effects in the form of increases in untreated self-stimulatory behaviors (Doke & Epstein, 1975, Epstein, et. al. 1974, Weisberg, et. al. 1973) occurrence of new self-stimulation and self-injury (Measel & Alfieri, 1976, Rollings, et. al. 1977), and inappropriate behaviors such as screaming and noise making (Doke & Epstein, 1975) to be associated with Overcorrection Procedure, this was not borne out in the current study for the negative behaviors (e.g. noncompliance and aggressive-disruptive behaviors) which were assessed. However, the results for these behaviors in the present study are based upon free response time and may be more reflective of the subject's responsiveness to the task demands than program implementation. Had data been collected during program implementation the results for these behaviors may have looked much different particularly for the Overcorrection Procedure which according to the therapists was
associated with more resistance upon the part of the subjects making it more difficult to implement. Difficulties in implementing overcorrection with individuals who are resistant and noncompliant are reported elsewhere in the literature (Foxx, 1978). Under these circumstances it can be punishing to the implementer, and presents the potential for physical injury to both the programmer and subject, making the procedure unfeasible (Foxx, 1978). Future research is required to address the procedural aspects of Overcorrection Program implementation to assess its effect on a wide range of potential negative collateral behaviors.

Another possible explanation for the failure to show a dramatic difference in negative collateral behaviors between the Visual Screening and Overcorrection Procedures is the form of Overcorrection utilized in this study. For instance, in the present study the procedural application of Overcorrection involved verbally and manually prompting subjects to engage in an adaptive component of the task (e.g. putting puzzle pieces in a puzzle) for a designated period of time (e.g. 10 seconds) rather than having the subjects practice alternative responses matched to the form of the target behavior (e.g. guiding hands through functional motor acts for 10 seconds). It is possible that in studies where the
latter form of overcorrection is used, the procedure is more aversive and subjects may be more resistant as manifested in increased oppositional-disruptive behaviors.

The purpose of using components of the task in the Overcorrection Procedure during the present study was based upon the belief that having subjects practice meaningless motor responses which are matched to the form of the targeted behaviors is ineffectual in teaching appropriate (adaptive) responses. However, in spite of the fact that the Overcorrection Procedure employed in the present study included components of the required task, this did not enhance the effectiveness of this procedure over Visual Screening in increasing on-task behavior.

The effectiveness of overcorrection in training and motivating appropriate behaviors is unclear. Roberts, Iwata, McSween and Desmond (1979) found that using a positive practice overcorrection procedure topographically different from the self-stimulatory behaviors of three profoundly retarded adults reduced stereotypic behaviors, while rates of appropriate incompatible behaviors remained variable or decreased during treatment. Increase in appropriate behaviors have not always occurred even when stereotypic responding was virtually eliminated by overcorrection (Wells, et. al.,
It appears that many researchers have ignored this long term goal in reducing self-stimulation or have assumed that appropriate behavior would automatically occur with suppression of stereotypy.

There continues to exist much debate about the essential components of the overcorrection procedure (Baumeister & Forehand, 1973; AABT Task Force, 1982; Schroeder, et. al. 1981); and researchers have recently begun to investigate these various aspects (Carey & Bucher, 1981). Parallels have been drawn between overcorrection and other punishment procedures in that they have the same advantages of rapid, dramatic and generally enduring suppression of stereotypic behaviors and disadvantages of negative modeling, emotional conditioning, counteraggression, escape behavior and substitution (Harris & Ersner-Hershfield, 1978).

Different components of this procedure have been found to suppress stereotypic responding including physical restraint (Shapiro, Barrett, & Ollendick, 1980; Ollendick, Shapiro, & Barrett, 1981), verbal warning (Wells, Forehand, Hickey, & Green, 1977), and positive practice without faded guidance (Ward, 1977).

Luiselli, et. al. (1979) found that brief physical contact (isolating body parts for 20 seconds) was effective in reducing hand clapping and body rocking in a 7 year old autistic child. Shapiro, et. al. (1980) found
that 30 second physical hand restraint and positive practice overcorrection were equally effective in treating stereotypic mouthing in 3 mentally retarded emotionally disturbed hospitalized children, whereas Ollendick, et. al. (1981) found these treatments to be differentially effective. Czyzewska, Barrera and Sulzer-Azaroff (1982) successfully applied an abbreviated overcorrection procedure to reduce several stereotypic behaviors and tantrums in a severely retarded child. Confusion surrounding the importance of the different components of this treatment as well as difficulty in modifying it to fit individual cases may be the basis for conflicting research findings regarding its effectiveness (AABT Task Force, 1981; Ollendick & Matson, 1978). Further research is needed to address the differential effects the different forms and components of overcorrection have on negative collateral behaviors and appropriate (adaptive) responding.

**Differential Treatment Effectiveness on Collateral Stereotypies**

The results of the present study which indicated changes in untreated stereotypic behaviors paralleling changes in targeted (treated) behaviors deserves particular attention. These results are consistent with previous findings (Zegiob et.al., 1978) which indicated that Visual Screening is not only effective in
suppressing various stereotypies but that the suppressive effects are generalized to untreated self-injurious and disruptive behaviors. One explanation for these results is that they reflect a spontaneous response to treatment of either one or both classes of stereotypic behaviors (e.g. mouthing, self-biting) in this study because these behaviors are of the same response class, share a common developmental basis, or have the same learning history. This is an etiological question referring to how such behaviors develop and/or are maintained, a discussion which extends beyond the scope of the present study. Future research is required to address the etiological, developmental questions centering around stereotypic behaviors.

Another possible explanation for the change in untreated collateral stereotypies is that such behaviors may have paralleled the increase in appropriate on-task behavior which was potentially incompatible with stereotypic responding. A number of studies (Davenport, Berkson, 1963; Favell, 1973; Landau, 1981; Mulick, Hoyt, Rojahn, & Schroeder, 1978) are cited as evidence that providing subjects with attenuation activities results in an alternative of such behaviors, particularly when these activities are reinforced (Hollis, 1968; Lovaas, et.al., 1965). However, an increase in on-task behavior alone, with or without reinforcement for this behavior does not
guarantee a reduction in other behaviors particularly if the collateral stereotypies are not incompatible with on-task behavior. For instance, some forms of stereotypies can occur while the subject completes required activities (Burkhart, 1980), particularly if they can complete activities without the use of both hands leaving one free to engage in stereotypic behaviors.

Although many investigators have shown a reduction in stereotypic responding with an increase in topographically incompatible responses (Berkson & Mason, 1964; Davenport & Berkson, 1963), Klier and Harris, (1977) found that this relationship is not so clear cut. Their results showed that four autistic children were able to learn two tasks, one which was and one which was not incompatible with stereotypic behaviors and without external suppression of the stereotypic responding.

If viewed from the perspective that untreated collateral stereotypic behaviors may be manifested as "symptom substitution" particularly when related behaviors are reduced, it is surprising that collateral stereotypies did not increase in the present study. Symptom substitution refers to the appearance of or increase in substitute behaviors following successful elimination of a particular problem or "symptom" (Kazdin, 1982). According to views stemming from the medical model, symptom substitution occurs as a result of failure
to treat the underlying psychological problem (Kazdin, 1975). From a behavioral perspective, the basis for symptom substitution is generally considered to be failure of a program to shape adaptive behaviors to take the place of inappropriate targeted behaviors. It is possible that once a deviant behavior is reduced, the individual has no socially appropriate response to take its place (Calhoon, 1968). The reason for failure to shape adaptive behaviors is often attributed to the power of the reinforcer used. If the reinforcer is not powerful enough, the individual will not be responsive and the behaviors which are reinforced will not be strengthened/increased. Viewed from this perspective it is possible that the reinforcer provided in this study influenced collateral stereotypic behaviors in a manner which prevented symptom substitution from occurring by rewarding non-occurrence of behaviors of a similar response class (e.g. mouthing and/or self-biting) and/or rewarding behaviors (e.g. on-task, hands down) which were incompatible with this class of behaviors, situations which are in fact mutually inclusive.

The success of differential reinforcement techniques may be due to the specific behavior(s) which are reinforced. For instance, Baily and Meyerson (1969) reinforced only one alternative response as opposed to any behavior other than the targeted response.
Similarly, Lovaas and Simmons (1969) were able to control head and arm banging by reinforcing behaviors such as clapping or rocking during a music activity. In the present study, only on-task and "hands down" responses were reinforced, behaviors which were incompatible with both treated and untreated stereotypies for all subjects.

The end result of either of the above explanations (e.g. symptom substitution or influence of DRI on behaviors) is consistent with research which has shown that for some subjects, several behaviors tend to be correlated to form clusters of responses (Kazdin, 1980). Response covariation is a concept which has been developed as an empirical alternative to symptom substitution (Kazdin, 1980). The above explanations might be combined to serve the conceptual basis of response covariation in referring to the therapeutic changes in one response of a cluster of behaviors which are likely to affect other associated responses (Kazdin, 1982). The accompanying changes associated with treatment of a particular behavior may be positive or negative depending upon the nature of behaviors which ordinarily covary with the target behavior (Kazdin, 1982).

The schedule of reinforcement appears to be an important component of this change process. For instance, when the schedule of reinforcement for one
component of a multiple treatment schedule is altered, the response under the unchanged component may also change, either in the same direction as the behavior in the altered aspect (induction) or in the opposite direction (contrast). Questions centering around the effects of DRI in the present study point to the importance of future research in determining influences of a DRI program on targeted and non-targeted behaviors and the concepts of behavioral induction and contrast.

**Treatment Interaction**

Research on behavioral contrast and induction in multiple treatment schedules has helped to clarify the nature and determinants of treatment interaction (Schwartz & Ganza, 1977). When more than one treatment is utilized it is possible that the effects of one treatment may be influenced by the effect of other treatments (Campbell & Stanley, 1963).

The concepts of symptom substitution and response covariation appear to be the focal points for debates centering around the problems of alternative treatments which logically leads into discussion of multiple treatment interference. Multiple treatment interference is identified through the lack of differential responding across treatments. This is evidenced in the present study through approximation of behavioral responses across treatment conditions in phase two for subjects 2
Recent studies have revealed that treatment interference or carryover effects from one treatment to another are oftentimes transient and a number of explanations have been cited for this phenomenon including inability of the subject to discriminate between treatment conditions (Blough, 1983; Hirson & Malone, 1980; McLean & White, 1981). Investigators have used a number of techniques to reduce multiple treatment interference including targeting easily reversible behaviors, utilizing treatments with little or no carryover effects, and using discriminative stimuli to signal initiation of a particular treatment (Barlow & Hirson, 1984; Burrios, 1984; Kazdin, 1982; Barrett, Watson, Shapiro, & Ollendick, 1981; Ollendick, Shapiro, & Barrett, 1981; Greenwald, 1976).

In the present study a number of techniques were utilized in an attempt to control for multiple treatment interference including use of both visual and auditory cues, and a changeover interval between treatments of at least 15 minutes. In a recent study in which multiple treatment interference was revealed, the changeover interval was increased from 1 to 120 minutes resulting in differential responding suggesting that multiple treatment interference depends, at least in part, on the changeover interval between treatments (McGonigle,
It should be noted that for both subjects 2 and 5 in the present study where multiple treatment interference was evidenced, DRI was used alone in phase one across all treatment sessions before the introduction of the punishment techniques in phase two in combination with the same DRI procedure counterbalanced with DRI alone. This may have been the basis for poor discrimination on the part of the subjects across the different treatment conditions in spite of the use of visual and auditory cues. Multiple treatment interference did not occur, however in the converse condition for subjects 3 and 4 where Visual Screening and Overcorrection were counterbalanced with a no-treatment session in phase one before the introduction of DRI in phase two.

None of the reviewed research to date has looked at the strategic application of a DRI component in the time sequence of a behavioral treatment package. In the present study, the purpose of implementing a DRI component early in the treatment phase in combination with a punishment technique, was based upon the belief that it would take longer for both target stereotypic acts and appropriate adaptive behaviors to respond since the retarded individual would have more contingencies to recognize. The converse condition of introducing the DRI component later in the treatment program was based upon
the belief that once the individual learned the consequences of his inappropriate (stereotypic) behavior, a more rapid increase in adaptive behaviors would occur. The purpose of adding a reinforcement component in the form of DRI to both Visual Screening and Overcorrection methods was an attempt to further elucidate the differential effectiveness of these procedures and support the use of one over the other. Research to date has not clarified the combined effects of Overcorrection and DRI on behavior (Azrin, et. al., 1975).

The strategic application of DRI in the present study showed that, whereas DRI applied later in a treatment package may enhance treatment effectiveness, implementation of DRI early in the treatment package prior to implementation of a punishment procedure may result in a confound of treatment effects. Reinforcement remains a crucial part of a treatment package for changing behaviors. However, results from the present study indicate that addition of a reinforcement technique does not necessarily result in an increase in the effectiveness of one punishment procedure over another.

Another treatment interaction effect in the present study was the increase in self-biting by subject 4 across all treatment conditions with the introduction of DRI in the second alternating treatment phase reflective of loss of behavioral control following the return to no-treat-
ment. The results for subjects 2, 3, 4, and 5 involving the strategic application of DRI and loss of behavioral control of subject 4 across treatment conditions point to the problems associated with a DRI treatment component and the need for further research to identify the influence of this technique both alone and in combination on targeted behaviors. The basis for the problems associated with a DRI procedure is most likely multifaceted. One explanation is that the value of the reinforcer must be powerful enough for a particular individual in order to impact upon targeted behaviors. Another explanation is that the DRI component of a treatment package can interact with and be affected by the nature of the targeted behaviors. For instance, the schedule of reinforcement is influenced by the rates of targeted behaviors such that when the rates are high opportunities for provision of reinforcement diminishes, nullifying the effects of this treatment. Another problem associated with differential reinforcement procedures includes the possibility that untreated self-stimulation may be paired with reinforcement. Although reinforcement of any behavior other than the targeted stereotypic response maximizes opportunities for reinforcement, this type of reinforcement schedule can also result in reinforcement of other maladaptive behaviors, (Young & Wincze, 1974). Young and Wincze,
(1974) suggested that the response which is reinforced be incompatible with not only the targeted behavior but all other stereotypic responses which exist in the individual's repertoire.

A final methodological problem associated with this study was the increase over time in adaptive (e.g. on-task) behavior of subject 3 with simultaneous reduction in inappropriate stereotypic behavior. Whereas these results may suggest spontaneous generalization across settings, another explanation might be that the subject was responding to conditions within the classroom setting which were not controlled for in the study. For instance, studies on stereotypic behaviors indicate that these behaviors respond to environmental conditions (Hutt & Hutt, 1965; Hutt et. al., 1965; Baumeister et. al., 1980) and that there is oftentimes an inverse relationship between stereotypic responding and appropriate object manipulation (on-task behaviors) (Koegel & Covelt, 1972, Risley, 1968).

Maintenance of Treatment Effectiveness

Results from the present study revealed maintenance of targeted behaviors following discharge from hospitalization for all subjects. These results support the effectiveness of a Visual Screening Procedure across settings and over time. The available data do not provide similar support for the Overcorrection Procedure.
Follow-up studies have failed to demonstrate sufficient maintenance of self-stimulation when overcorrection procedures were faded. Although durable response inhibition has been demonstrated up to 12 months in children (Freeman, et. al., 1977; Luiselli, et. al., 1977), results with adults are less encouraging (Rollings, et. al., 1977; Jones & Kazdin, 1975).

Several important questions remain regarding the use of the overcorrection procedure including the components which it incorporates, and inconsistent results regarding its effectiveness and generalization. Overcorrection might be considered a procedure which takes advantage of the combination of several techniques. Initially, overcorrection was considered a re-educative process involving negative reinforcement (Foxx & Azrin, 1973), but more recently it has been considered a milder variant of punishment (Axelrod, 1978; AABT Task Force, 1982; Forehand & Baumeister, 1976; Hobbs, 1976; Schroeder, et. al., 1981).

Further research is necessary to assess the procedural components (e.g. physical restraint, duration, maintenance) of both Overcorrection and Visual Screening techniques. Because Visual Screening is a relatively new procedure questions remain about its effectiveness across other behaviors (e.g. aggression, disruption, individuals, and conditions). Future research is
required to replicate the results of the present study and to address these questions.
APPENDIX A
BEHAVIOR RATING SCALES
### Profile Summary

**AAMD Adaptive Behavior Scale Part Two**

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### PROFILE SUMMARY

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**Identification**: Subject 4

**Age**: 

**Sex**: 

**Date of Administration**: 

**Attained Scores**: 11 0 9 0 8 12 0 3 14 5 5 3 6 0
**Identification**

Subject 5

Age __________________________

Sex __________________________

Date of Administration ______________________

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| Psychological Disturbances | | | | | | | | | | | | | | | | | | | | | |
| Sleep Disorder | | | | | | | | | | | | | | | | | | | | | |
| Anxiety | | | | | | | | | | | | | | | | | | | | | |
| Depression | | | | | | | | | | | | | | | | | | | | | |
| Self-Abuse | | | | | | | | | | | | | | | | | | | | | |
| Aggression or Combative Behavior | | | | | | | | | | | | | | | | | | | | | |
| Inappropriate Verbal Habits | | | | | | | | | | | | | | | | | | | | | |
| Inappropriate Interpersonal Manner | | | | | | | | | | | | | | | | | | | | | |
| Unascertainable Behavior | | | | | | | | | | | | | | | | | | | | | |
| Withdrawn | | | | | | | | | | | | | | | | | | | | | |
| Unassertive Behavior | | | | | | | | | | | | | | | | | | | | | |
| Rebellious Behavior | | | | | | | | | | | | | | | | | | | | | |
| Antisocial Behavior | | | | | | | | | | | | | | | | | | | | | |
| Violent 
& Destructive Behavior | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |

Date of Administration

Sex

Age

Identification - Subject ID
**ABERRANT BEHAVIOR CHECKLIST**

**SCORE SHEET**

Resident's Name: Subject 1

Date: ___________________________ Study Phase: ___________________________

Rater: ____________________________________________

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ABERRANT BEHAVIOR CHECKLIST

SCORE SHEET

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Date: __________________________ Study Phase: ___________________

Rater: __________________________

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ABERRANT BEHAVIOR CHECKLIST

SCORE SHEET

Resident's Name: **Subject 3**

Date: ________________________ Study Phase: ________________________

Rater: ________________________

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ABERRANT BEHAVIOR CHECKLIST

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Date: _________________________ Study Phase: _______________________
Rater: _______________________

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# ABERRANT BEHAVIOR CHECKLIST

## SCORE SHEET

Resident's Name: **Subject 5**

Date: ____________________________ Study Phase: ____________________________

Rater: ______________________________________________________________________

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ABERRANT BEHAVIOR CHECKLIST

SCORE SHEET

Resident's Name: Subject 6

Date: ______________________ Study Phase: ______________________

Rater: ______________________

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APPENDIX B
EXPERIMENTAL GROUPS
AND TREATMENT PROCEDURES
# EXPERIMENTAL GROUPS AND TREATMENT PROCEDURES

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Observer: _________________________

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On-task: / = Mouthing: / = Opposition/Disruption: / =
Self-Stimulation: / = Self-Injury: / = In-Seat: / =
Reliability Checker: ____________________________
APPENDIX D
CONSENT FORMS
CONSENT FOR PARTICIPATION IN
SOCIAL AND BEHAVIORAL RESEARCH

I consent to participating in (or my child's participation in) research entitled:

Evaluation of overcorrection and visual screening procedures in combination
with DRI for reducing stereotypic responding and increasing adaptive behavior
in mentally retarded children, or his/her authorized representative has

(Principal Investigator)

explained the purpose of the study, the procedures to be followed, and the expected duration of my (my child's) participation. Possible benefits of the study have been described as have alternative procedures, if such procedures are applicable and available.

I acknowledge that I have had the opportunity to obtain additional information regarding the study and that any questions I have raised have been answered to my full satisfaction. Further, I understand that I am (my child is) free to withdraw consent at any time and to discontinue participation in the study without prejudice to me (my child). The information obtained from me (my child) will remain confidential unless I specifically agree otherwise by placing my initials here _______.

Finally, I acknowledge that I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Date: ___________________ Signed: ___________________(Participant)

Signed: ___________________ Signed: ___________________(Principal Investigator or his/
her Authorized Representative) (Person Authorized to Consent
for Participant - If Required)

Witness: ___________________

RS-027 (Rev. 12-81) -- To be used only in connection with social and behavioral research.
CONSENT TO PARTICIPATE IN A CLINICAL STUDY
(Parents/Guardians)

TITLE: Evaluation of Overcorrection and Visual Screening Procedures in Combination with the DRI for Reducing Stereotypic Responding and Increasing Adaptive Behavior in Mentally Retarded Children

INVESTIGATORS:

Jennifer E. Burkhart, M.A. 
James B. Payton, M.D. 
Department of Psychiatry 
University of Pittsburgh 
School of Medicine 
Pittsburgh, PA 15213 
(412) 624-2317 or 3963

Henry Leland, Ph.D. 
Nisonger Center 
The Ohio State University 
Columbus, OH 43210 
(614) 422-9605

DESCRIPTION: I understand that the purpose of this study is to determine how effective two different behavior management methods are in reducing problem behaviors which prevent my child from carrying out normal everyday activities. These behaviors include biting self and putting hands and objects in the mouth. I understand that I have been asked for my child's participation in this study because he/she has many of these problem behaviors. There will be six children ages 3-12 years in this study which will last a total of 60 days. I understand that during this time my child will be involved in daily work sessions with a highly trained and experienced therapist. The therapist will use procedures in these sessions which are routinely used on the John Merck Unit to treat problem behaviors. These procedures, which have been explained to me, will include covering my child's eyes for 10 seconds or physically making him/her do the required activity immediately following the mouthing or biting. I understand my child will also be rewarded with praise and attention for doing activities on his/her own.

RISKS/BENEFITS: I understand that risks of this study include normal risk of accidental injury which exists with any child who shows high rates of behaviors which can cause self-injury. I also understand that sometimes children also become aggressive and disruptive when procedures are implemented to reduce other problem behaviors. It has been explained to me and I understand that the staff of the John Merck Program Inpatient Unit are highly trained and experienced in implementing behavior management procedures and all the usual precautions will be taken to interrupt these behaviors and to prevent my child from hurting himself/herself or others. However, I also understand that the procedures used in this study may not cause any physical or emotional danger to my child.

3811 O'HARA STREET, PITTSBURGH, PA. 15213

Initials:________________________
ALTERNATIVE TREATMENTS: I understand that treatment of problem behaviors on the John Merck Program Inpatient Unit are not restricted to these procedures alone nor are these procedures used exclusively for treating problem behaviors. Therefore I understand that alternative procedures are available and will be used if the procedures in this study prove to be ineffective.

COST AND PAYMENTS: I understand that the procedures used in this study are part of the treatment programs routinely used on the John Merck Program Inpatient Unit and no payment or reimbursement will be provided to me. I also understand that all normal costs of hospitalization not related to this research will be charged to me.

CONFIDENTIALITY: I have been assured by the investigators that any information obtained from this research will be kept strictly confidential and that such information carrying personal identifying material will be kept in locked files and made available only to the clinical staff and research team. It has been explained to me that no verbal or written information concerning my child will be released without expressed written consent and any description or publications of this research will not divulge any information which may reveal the identity of my child. Therefore, by affixing my signature below I consent to such publication for scientific purposes. I understand that my child's research records, just like hospital records, may be subpoenaed by court order.

RIGHT TO REFUSE OR TO END PARTICIPATION: I understand that I may refuse to allow my child to participate in this study or to end his/her participation at any time and that my decision will not adversely affect his/her care at this Institution or cause loss of benefits to which I and my child might otherwise be entitled.

NO COMPENSATION FOR PHYSICAL INJURY OR ILLNESS: I understand that in the event of a physical injury or illness resulting from the research procedure no monetary compensation will be made. Emergency medical treatment which may be necessary will be made available to me without charge.
VOLUNTARY CONSENT: I certify that I have read the preceding or it has been read to me and that I understand its contents. Any questions I have pertaining to the research have been and will be answered by __________________________. Any questions I have concerning my child's rights as a research subject will be answered by the Office of the Senior Vice Chancellor, Health Sciences (Phone No: (412) 624-2600). A copy of this consent form will be given to me. My signature below means that I have freely agreed to my child's participation in this experimental study.

Date ____________________________ Subject/Patient Signature ____________________________

Witness ____________________________

ACKNOWLEDGEMENT OF PARENT OR GUARDIAN

For Minors:

I, ________________________________, have also read the preceding and agree to the participation of my child.

Date ____________________________ Parent/Guardian ____________________________

Witness ____________________________

INVESTIGATOR'S CERTIFICATION:

I certify that I have explained to the above individual the nature and purpose, the potential benefits, and possible risks associated with participating in this research study, have answered any questions that have been raised, and have witnessed the above signature.

Signature of Investigator: ____________________________

Date: ____________________________
CONSENT TO PARTICIPATE IN A CLINICAL STUDY
(Parents/Guardians)

TITLE: Evaluation of Overcorrection and Visual Screening Procedures in Combination with the DRI for Reducing Stereotypic Responding and Increasing Adaptive Behavior in Mentally Retarded Children

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NO COMPENSATION FOR PHYSICAL INJURY OR ILLNESS: I understand that in the event of a physical injury or illness resulting from the research procedure no monetary compensation will be made. Emergency medical treatment which may be necessary will be made available to me without charge.

Initials:_________
VOLUNTARY CONSENT: I certify that I have read the preceding or it has been read to me and that I understand its contents. Any questions I have pertaining to the research have been and will be answered by __________________________. Any questions I have concerning my child's rights as a research subject will be answered by the Office of the Senior Vice President, Health Sciences (Phone No: (412) 624-[0874]). A copy of this consent form will be given to me. My signature below means that I have freely agreed to my child's participation in this experimental study.

Date Subject/Patient Signature

Witness

ACKNOWLEDGEMENT OF PARENT OR GUARDIAN

For Minors:

I, __________________________________, have also read the preceding and agree to the participation of my child.

Date Parent/Guardian

Witness

INVESTIGATOR'S CERTIFICATION:

I certify that I have explained to the above individual the nature and purpose, the potential benefits, and possible risks associated with participating in this research study, have answered any questions that have been raised, and have witnessed the above signature.

Signature of Investigator: __________________________

Date: __________________________
References


