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Functional Analysis and Assessment-based Interventions for Aberrant Behavior of Children with Developmental Disabilities

Hui-chuan Chu*

ABSTRACT

The purpose of the study was to develop a comprehensive functional analysis methodology for use in different applied settings and examine the efficacy of this methodology in identifying maintaining variables of aberrant behaviors on an individual basis, and to further investigate the effects of the functional assessment-based interventions on the aberrant behaviors and appropriate behaviors of the children with developmental disabilities.

The participants in the study were three children with developmental disabilities who frequently exhibit serious aberrant behaviors. This study consisted of two phases: (1) the functional analysis phase and (2) the intervention phase. During the functional analysis phase, the alternating treatments design was used. The aberrant behaviors of three participants were observed during periods of brief, repeated exposure to a series of twelve types of experimental conditions in an instructional setting or a free play setting. During the treatment phase, a reversal design was employed to examine the effects of the assessment-based interventions on the rates of aberrant behaviors and adaptive behaviors of the participants.

The results of the study indicated that the functional analysis methodology was effective in analyzing the functions of aberrant behaviors in different settings, and the implementation of the intervention based on the results of functional analysis could substantially decrease aberrant behaviors and increase appropriate

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behaviors. The findings of this study could serve as a basis for the continued refining of functional analysis methodology, and led to a better understanding of the functional properties of aberrant behaviors on an individual basis and the development of more effective interventions for increasing appropriate behaviors and reducing aberrant behaviors.

Key words: Functional Analysis, Developmental Disabilities, Aberrant Behaviors, Intervention Strategies

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INTRODUCTION

Aberrant behaviors such as stereotypy, self-injury, and aggression are among the most prevalent behavior disorders observed in children with developmental disabilities (Harris, 1993; Sigafoos & Saggers, 1995). Available data suggest that as many as 40% to 60% of these individuals exhibit stereotypic behavior, 6.5% to 40% emit self-injurious behavior, and 14% to 38% exhibit aggressive and destructive behaviors (e.g., Bodfish, Crawford, Powell, Parker, Golden, & Lewis, 1995; Griffen, Williams, Stark, Altmeyer, & Mason, 1986; Jacobson, 1982; Murphy, Macdonald, Hall, & Oliver, 2000). Aberrant behavior represents a major obstacle to the habilitation of individuals with developmental disabilities (Meyer & Evans, 1989), and is the single most important factor leading to institutionalization or placement in a more restricted setting (Harris, 1993; Eyman, O'Connor, Tarjan, & Justine, 1972). Thus, a large portion of interventions for children with developmental disabilities is justifiably concerned with treatment of problem behaviors that are serious enough to jeopardize the safety and effective functioning of these children.

Recent studies on interventions for aberrant behaviors have focused on an understanding of the function of aberrant behavior for an individual (Neef & Iwata, 1994). There is strong evidence that knowledge of the variables controlling a variety of topographies of aberrant behavior including self-injury, aggression, pica, and stereotyped behavior can lead to more effective

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interventions (e.g., Repp & Karsh, 1994; Vollmer, Northup, Ringdahl, LeBlanc, & Chauvin, 1996). Reviews of the existing literature indicate that the maintaining mechanism for the majority of aberrant behaviors is operant in nature, and some aberrant behaviors may be governed by biological factors (e.g., Carr, 1994; Sandman, 1991). The major research findings related to the role of operant conditioning and biological variables in the genesis and maintenance of aberrant behavior will be reviewed because of their relevance to a more thorough understanding of aberrant behavior and to the development of more effective interventions.

Environmental Variables of Aberrant Behaviors

Generally, environmental variables have been found to occasion or maintain a variety of aberrant behaviors via (1) environmental positive reinforcement contingencies (e.g., attention seeking, access to tangible items or events), (2) environmental negative reinforcement contingencies (e.g., avoidance or escape from demands), (3) automatic positive reinforcement contingencies (e.g., the generation of sensory or perceptual reinforcement), or (4) automatic negative reinforcement contingencies (e.g., pain-terminating or pain-attenuating behavior). First of all, environmental positive reinforcement may often take the form of attention from others and access to tangible items or events. Social attention in its various forms (teacher, peer, staff, sibling, and parental attention) have been shown to systematically influence a variety of maladaptive behaviors, including self-injury (e.g., Carr & McDowell, 1980), aggression (e.g., Mace, Page, Ivancic, & O'Brien, 1986), noncompliant behavior (e.g., Riemers, Wacker, Cooper, Sasso, Berg, & Steege, 1993), and disruptive behavior (e.g., Northup, Broussard, Jones, George, Vollmer, & Herring, 1995). The establishing condition of attention deprivation typically involves two different situations presenting low levels of social attention: (1) diverted attention--significant others engage in activities which divert their attention away from the subject (e.g., Carr & McDowell, 1980); and (2) divided attention--significant others' attention is divided between the subject and another individual (e.g., Taylor, Sisson, McKelvey, & Trefflner, 1993). For example, an analysis by Carr and McDowell (1980) showed that self-injurious scratching by a school age male was positively reinforced by diverted parental attention (watching television), whereas Taylor et al. (1993) provided evidence that a participant emitted the highest level of aggressive scratching in a divided

attention condition in which the participant's teacher talked with other adults and students and ignored the participant except to scold the participant contingent upon each instance of scratching. In addition, peer attention as a distinct form of positive reinforcement has been shown also to reinforce maladaptive behaviors. Northup et al. (1995) found disruptive classroom behavior in children with a diagnosis of attention deficit hyperactivity disorder to be a function of contingent peer attention. More specifically, for all three participants, contingent peer attention resulted in a substantially higher percentage of disruptive behaviors than did teacher attention.

Researchers have also found that various aberrant behaviors such as self-injury (e.g., Day, Rea, Schussler, Larsen, & Johnson, 1988) and aggression (e.g., Sigafoos & Saggers, 1995) are positively reinforced by access to activities or items such as toys, music, television, and foods that may not be easily obtained through an individual's adaptive repertoire. Greer, Becker, Saxe, and Mirabella (1985) provided one of the first experimental demonstrations of the influence of specific tangible items on aberrant behavior. In the experiment of their study, the researchers found that removal of the preferred toys from severely retarded individuals with no history of stereotypy evoked stereotypy, and reinstatement of the preferred toys eliminated the aberrant behavior. More recent studies showed another example of aberrant behavior maintained by tangible positive reinforcement. In a functional analysis of aggressive behavior conducted by Sigafoos and Saggers (1995), one assessment condition involved delayed access to the preferred item, rather than removal of the preferred item. This variation was used to determine if presence of a preferred item was sufficient to occasion aggression. The results of the study showed that one participant's aggressive behavior occurred at high rates and exclusively during this tangible condition.

Second, research has suggested that a significant number of developmentally disabled individuals appear to emit frequent escape-avoidance motivated behavior (Carr & Newsom, 1985). Numerous studies have shown that a variety of aberrant behavior including aggression (e.g., Carr et al, 1980), self-injury (e.g., Iwata et al., 1982/1994), psychotic speech (Durand & Crimmins, 1987), and stereotypy (Durand & Carr, 1987) can be maintained by escape from or avoidance of an aversive stimulus. Aberrant behavior may function to alleviate aversive conditions, remove already-present aversive stimuli, delay the presentation of

aversive stimuli, or avoid aversive stimuli completely. In a series of studies by Carr and his associates (e.g., Carr & Newsom, 1985; Carr et al, 1980), the researchers employed rigorous experimental methods to contrast the presence and absence of demand conditions, and they found that aggressive or tantrum behaviors occurred at high rates during demand conditions but rarely occurred in the absence of demands. Moreover, task difficulty as one dimension of demands that relate to task avoidance have been investigated. In an experiment conducted by Mace et al. (1987), two dimensions of task difficulty were investigated: one was the number of required responses (i.e., high versus low response activities), and the other was the participant's familiarity or reinforcement history with a particular task (i.e., familiar versus novel activities). The results of the study showed that more difficult tasks (i.e., tasks that required a greater number of responses or those with which the participant had no known reinforcement history) were associated with higher levels of stereotypy than tasks requiring fewer responses or than tasks for which the participant had developed skills. Iwata et al. (1994) presented data from 152 single-subject analyses of the contingencies that maintained self-injurious behavior (SIB). The data showed that environmental negative reinforcement (i.e., escape from task demands or other varying sources of aversive stimulation) accounted for the largest proportion of SIB (38.1%). That is, 38.1% (i.e., 58 subjects) of the sample emitted SIB that was maintained by environmental negative reinforcement.

Third, some aberrant behaviors appear to occur independent of social consequences. Iwata, Vollmer, and Zarcone (1990) have indicated that the term "automatic reinforcement" seems most desirable as a functional description of the maintaining contingency of such a behavior because this term "connotes the fact that behavior occurs independent of the social environment, as well as the fact that either positive or negative reinforcement may be involved" (p. 303). A number of underlying mechanisms and theories have been proposed to account for the occurrences of these behaviors. Baumeister and his associates (e.g., Baumeister & Rollings, 1976; Baumeister, 1989) proposed a theory based on the individuals' need for optimal level of stimulation (probably for survival reasons) as the possible genesis and maintenance of aberrant behavior. Baumeister's homeostasis/arousal theory states that when individuals are overrstimulated or understimulated they will engage in various types of behavior, including aberrant behaviors, to decrease or

increase their arousal state. That is, aberrant behaviors are seen as a reaction to either too much or too little environmental stimulation. Lovaas, Newsom, and Hickman (1987) proposed a perceptual reinforcement hypothesis based on numerous observations of individuals with developmental disabilities, whose stereotyped behaviors produced perceptual stimulation that has powerful reinforcing properties. More specifically, Lovaas et al. (1987) considered stereotyped behaviors as a class of operant behaviors maintained by their automatically produced internal or external stimulation. Internal stimulation, for example, may take the form of vestibular feedback from the ear produced by body-rocking, and external stimulation may take the form of visual feedback from a spinning object (see Lovaas et al., 1987, for a complete review).

A number of studies supporting that various aberrant behaviors may be positively reinforced by the automatic sensory or perceptual consequences that the behaviors directly produce have been conducted through two types of experimental manipulations. One method involves masking the auditory, proprioceptive, kinesthetic, tactile, or vestibular consequences directly produced by aberrant behavior, thereby producing extinction. Rincover (1978) termed this process as sensory extinction. Using this experimental paradigm, aberrant behavior is hypothesized to be positively reinforced by the sensory or perceptual consequences that the maladaptive response produces. If aberrant behavior is decreased or eliminated as a result of the sensory extinction procedures, it is inferred that the maladaptive responses are maintained by automatic positive reinforcement. For example, Rincover and Devany (1982) used the sensory extinction procedures to reduce self-injurious behaviors by removing the tactile stimulation from head-banging and face-scratching. By having two of the three participants in the study wear equipment (i.e., padded helmet and rubber gloves), the rates of self-injurious behavior decreased significantly. The third participant's head-banging was immediately and sharply reduced by padding the walls and floor of a room.

A second method involves assessing functional relations between antecedent and concurrent environmental variables and aberrant behaviors. A number of studies have shown that "austere" (Horner, 1980) or "barren" (Carr, 1977) environments, including the absence of leisure or educational materials (e.g., Greer et al., 1985; Horner, 1980) were associated with increases in aberrant

behaviors that provide automatic positive reinforcement. Other studies involve providing access to alternative sources of stimulation, whose reinforcement might compete effectively with that obtained through aberrant behavior. For example, in an experiment of the Greer et al. (1985) study, the reasearchers demonstrated that individuals who engaged in high rates of stereotypy could be conditioned to play with balls through training, and that ball play competed successfully with stereotypy. The results showed that the training resulted in substantially less stereotypy and substantially more ball play in separate free operant sessions, suggesting that a ball play could be conditioned as a positive reinforcer which, in turn, replaced the automatically produced reinforcers that account for the maintenance of stereotypy.

Lastly, aberrant behaviors that produce automatic negative reinforcement directly terminate or at least attenuates ongoing aversive stimulation. That is, automatic negative reinforcement may result from pain-terminating behavior such as face hitting, or pain-attenuating behavior such as head banging and self-scratching (Carr & McDowell, 1980). For example, face hitting may persist when more adaptive means of terminating localized pain to the face are not available, and head banging may function to attenuate aversive symptoms that are produced by ear infections (Iwata, Zarcone, Vollmer, & Smith, 1994).

Automatic negative reinforcement has not been investigated extensively. A number of correlational analyses have suggested that aberrant behaviors of this type may be associated with several medical conditions such as headaches, dermatitis (Cataldo & Harris, 1982), and ear infections (DeLissovoy, 1963). Automatic negative reinforcement may also account for observed functional relations between specific environmental stimulation and aberrant behaviors. For example, one person may yell loudly to mask another individual's screaming (Iwata, Vollmer, & Zarcone, 1990).

Biological Variables of Aberrant Behaviors

Some aberrant behaviors are maintained, at least in part, by biological variables. Cataldo and Harris (1982) suggested that some self-injurious behavior may be induced through biological mechanisms, such as deficiencies in biochemicals necessary for normal brain functioning, altered neurological input, neurological insensitivity to pain, and the body's ability to produce opiate-like substances (endogenous opiates) in response to pain and injury (see Cataldo &

Harris, 1982, for a complete review). A number of the hypotheses have also been proposed to account for these biological mechanisms. For example, the opiate hypothesis assumes that self-injurious behavior results in the release of endogenous opiates, which either increase the pain threshold or produce a "high" for the individuals and supply a "fix" for an addicted endogenous opiate system. Thus, individuals engage in self-injurious behavior either because they are partially analgesic or because they become addicted to their own aberrant behavior (Sandman, 1991).

The finding that opiate antagonists attenuate self-injurious behavior provides strong supporting evidence of the opiate hypothesis (e.g., Sandman, Barron, & Colman, 1990; Sokol & Campbell, 1988). Opiate antagonists such as naloxone and naltrexone have been used to increase sensitivity to pain-producing stimuli, thereby decreasing the pain-perception threshold to enhance automatic punishment of self-injurious behavior. In addition, these drugs may function to prevent a "high" for the individual who emits self-injurious behavior, thereby decreasing or extinguishing the behavior. For instance, Sandman, Barron, and Colman (1990) conducted a double-blind study of naltrexone in four mentally retarded individuals aged 23 to 26 years with self-injurious behavior. All participants were challenged with 4 fixed doses (0, 25, 50, 100 mg) of naltrexone and received each dose on a different week as determined by latin square design. Naltrexone was reported to have suppressive effects on the self-injurious behaviors of all participants. Three of the four participants decreased their self-injurious behavior as dose of naltrexone increased. The results of this study suggest a role of endogenous opiates in self-injurious behavior. In addition, opiate antagonists have also been reported to have positive effects on the reduction of withdrawal (e.g., Campbell, Overall, & Small, 1989), aggression, and hyperactivity (e.g., Campbell, Small, Perry, & Green, 1986).

In addition to opiate antagonists, other medications such as lithium, clomipramine, and haloperidol have been shown to be effective in suppressing aberrant behavior. For example, aggressive and destructive behaviors have been responsive to lithium carbonate (e.g., DeLong & Aldershof, 1987); stereotyped and related repetitive behavior and also self-injurious behavior have responded favorably to clomipramine treatment (e.g., Aman & Singh, 1988; Lewis, Bodfish, Powell, & Golden, 1995; Lewis & Golden, 1996); and autistic like behavior,

aggressiveness, impulsivity, and hyperactivity have been treated successfully with haloperidol (e.g., Joshi, Capozzoli, & Coyle, 1988). The results of these studies provide strong evidence of the biochemical abnormality hypothesis. The hypothesis assumes that if specific pharmacologic treatments of aberrant behaviors are selected based on underlying biochemical abnormalities, the aberrant behaviors could be treated successfully with those medications. The hypothesis and its supporting research findings again point to the presence of possible biological variables maintaining aberrant behavior.

Aberrant behaviors can also be induced through various chemical preparations such as ingestion of caffeine (Podboy & Mallory, 1977) or alcohol (Charmove & Harlow, 1970). For example, as cited in Carr (1994), Podboy and Mallory (1977) investigated the effects of caffeine on the aggressive behavior of severely retarded individuals. In a double-blind procedure, all participants were served with caffeinated and noncaffeinated coffee, and they were found to decrease their aggressive behavior during the condition with noncaffeinated coffee. The results of the study also demonstrated the impact of biochemical variables such as drugs on aberrant behavior.

Finally, aberrant behaviors have been related to several medical problems such as ear infection (DeLissovoy, 1963) and gene-linked disorders such as Lesch-Nyhan Syndrome (Lesch & Nyhan, 1964). Lesch-Nyhan Syndrome, for example, has been found to be invariably associated with self-injurious behavior. This finding provides evidence that some aberrant behavior is governed by biological variables. However, research has shown that even aberrant behaviors induced through biological mechanisms may still maintained by environmental or behavioral variables. For example, in a study by Anderson, Dancis, and Alpert (1978), the effects of noncontingent attention versus attention contingent on the self-injurious behavior of participants with Lesch-Nyhan Syndrome were investigated. Contingent attention occurred in the form of quick intervention to prevent self-injurious responses followed by reassuring statements and stroking the child. Self-injury occurred at extremely high rates during the contingent attention condition. This study suggests that even behavior induced by biological causation may still be maintained by environmental and behavioral variables.

Functional Analysis

To date, three types of functional assessment methods have been developed to

identify the circumstances under which aberrant behavior occurs: indirect informant approaches such as rating scale (e.g., the Motivation Assessment Scale; Durand & Crimmins, 1992) or structured interview procedures (e.g., the Functional Assessment Interview; O'Neil, et al., 1997), descriptive observational procedures such as A-B-C observations or scatterplots, and experimental functional analysis approaches (e.g., Carr & Durand, 1985; Iwata, Dorsey, Slifer, Bauman, & Richman, 1994; Taylor, Sisson, McKelvey, & Trefflner, 1993). Researchers have found experimental functional analyses to be an effective and time efficient methodology to use in identifying potential maintaining variables (Gable, Hendrickson, & Sasso, 1995). Other functional assessment methods may often produce invalid or ambiguous information or may require a considerable amount of time to collect and analyze data (Arndorfer, Miltenberger, Woster, Rortvedt, & Gaffaney, 1994).

Numerous studies have demonstrated that the results of functional analyses can significantly improve the design and selection of treatment procedures (e.g., Carr, 1994; Northup, Broussard, Jones, George, Vollmer, & Herring, 1995). Given the advantages, many researchers have suggested that intervention efforts should begin with a functional analysis and that hypotheses derived from such an analysis should form the basis for choosing and developing interventions (Carr, 1994). This approach has come to be known as the functional analysis model of assessment and treatment.

Of the functional analysis methodologies described in the literature, three types of analysis practices have evolved to identify various contingencies which may contribute to an individual's aberrant behavior: (1) the traditional or extended functional analysis, (2) the brief functional analysis, and (3) the discrete-trial approach to the functional analysis. The traditional or extended functional analysis was being developed by Iwata, Dorsey, Slifer, Bauman, and Richman (1982). This development was a major breakthrough in assessment research because it converted all three of Carr's (1977) hypotheses into a practical procedure for identifying the variables controlling aberrant behavior. In this methodology, the children were exposed individually to each of four conditions. During one condition, an adult read a book (diverted attention) and ignored the participant except to express social disapproval (e.g., Don't do that, you're going to hurt yourself.") contingent upon each instance of self-injury. In another

experimental condition, the researcher presented task demands and then withdrew those demands contingent upon each occurrence of self-injury. This methodology also included an "alone" condition to test for automatic reinforcement and a play condition to serve as a control for other conditions. A substantial body of empirical studies has demonstrated that this set of analog assessment including four different conditions has proven extremely prescriptive in terms of the selection and design of effective intervention strategies. However, there are limits to the extended functional analysis methodology. First, there remain questions about the social and ecological validity of analogue assessment procedures; that is, the results of analog assessment may not necessarily reflect variables maintaining aberrant behavior in natural or typical settings (Conroy, Fox, Crain, Jenkins, & Belcher, 1996). Second, an extended functional analysis of controlling variables for aberrant behavior in a setting typically consists of 30 to 70 sessions which are repeated over an extended period of time from 4 to 12 days (e.g., Iwata et al., 1982/1994), and requires rigorous experimental control. Thus, procedural implementation of the extended functional analysis has been generally characterized as cumbersome, time consuming, labor-intensive and costly, which makes it difficult to conduct in most educational or applied settings.

Some variations on the functional analysis methodology have been proposed in response to these theoretical and practical limits. For example, Northup et al. (1991) developed a brief functional analysis methodology in which the maintaining variables of aberrant behavior could be assessed in 90minutes or less. The assessment procedure involved a series of brief (5 to10 min) analog conditions and a contingency reversal phase in which appropriate response was reinforced, while aberrant response was ignored. Intervention effects could be demonstrated if the participant increased appropriate response that produced the same reinforcer shown to maintain aberrant behavior in analog assessment conditions and simultaneously decreased his/her aberrant response. Several researchers (e.g., Derby et al., 1992; Harding et al., 1994; Vollmer et al., 1996;) also incorporated functional communication training into the brief functional analysis methodology. In these studies, functional communication training involved teaching an adaptive alternative that was functionally equivalent to the aberrant behavior. After the performance criterion of the adaptive alternative was reached, the effectiveness of training was assessed during the contingency

reversal phase. Researchers have found that brief and extended functional analyses yield comparable results (Tincani et al., 1999) and the brief functional analysis is a time efficient method to use in identifying maintaining variables of aberrant behavior. In addition, since this methodology has focused on directly linking assessment to treatment, another advantage of the brief functional analysis is that effective interventions could be developed or selected more efficiently.

In another variation, Sigafoos and Meikle (1996) developed a discrete-trial approach to the functional analysis. The unique aspect of this approach was that the series of brief (2 min) functional analysis trials were incorporated by a teacher into the natural classroom routine. In this assessment approach, trials were conducted under four conditions: teacher attention, tangible reinforcement, escape from demands, and sensory reinforcement. Sixteen trials under each of four conditions were conducted per day over a five-day period. These trials were distributed throughout the school day at randomly selected times. Each trial consisted of two parts, each of which lasted only one minute. For example, during the first part of the attention trials, a teacher completed some paperwork and ignored the participant except to spoke to the child contingent upon each instance of aberrant behavior for up to one minute. Next, for the entire one-minute duration of the second part of the trial, the teacher provided the child with her undivided attention. It was hypothesized that the participant would emit higher level of aberrant behavior in the first part of the attention trials in comparison to the second part of the trials if the participant's aberrant behaviors were maintained by positive reinforcement in the form of teacher attention. This discrete-trial approach is a viable method for conducting functional analyses in most educational settings as it does not require significant changes in the natural environment (e.g., the alone condition) or removal of participants from the classroom or program routine.

Carr (1994) suggested that the advantages of functional analysis might be further extended by an examination of other possible functional properties of problem behaviors. In addition, Mace, Lalli, and Lalli (1991) indicated that results are more likely to generalize to the extent that natural and analog conditions overlap. Several investigators have stressed the need for future research to incorporate ongoing advancements in functional assessment methodology and to build a technology of functional assessment that meets the

range of situations faced in applied setting (Conroy, et al., 1996; Cunningham & O'Neill, 2000; Sugai, Sprague, & Horner, 1999). Thus, one of the purposes of this study was to develop a more refined variation of the technique to increase the efficacy of the functional analysis methodology.

Functional Assessment-based Interventions

The most frequently mentioned functional assessment-based interventions are functional communication training (FCT) (Carr & Durand, 1985; Durand, 1990) and functional equivalence training (FET) (Horner & Day, 1991). In FCT or FET studies, it is assumed that if individuals can gain access to desired consequences that maintain his or her aberrant behavior at a higher rate and/or more efficiently with a new communicative behavior or a socially appropriate response that is functionally equivalent to their aberrant behavior, they will increase their use of this new alternative, thereby reducing their use of the aberrant behavior. Thus, FCT and FET studies generally incorporate a pretreatment functional analysis of aberrant behavior and a training phase that teaches functionally equivalent communicative behaviors or socially appropriate responses. For example, in a classic FCT study, Carr and Durand (1985) conducted functional analyses to identify the variables maintaining the aberrant behaviors, including tantrums, aggression, and self-injury, of the four developmentally disabled participants. The results showed that three participants' aberrant behaviors were occasioned or maintained by either positive reinforcement in the form of adult attention or negative reinforcement in the form of escape from difficult task demands, while the aberrant behaviors of one participant were under both positive and negative reinforcement control. In the subsequent training phase, the aberrant behaviors of the four participants decreased significantly when they were taught to solicit praise or to request assistance or both.

The effectiveness of functional communication training and functional equivalence training has been well established in numerous studies (see Reichle & Wacker, 1993 and Durand & Merges, 2001, for comprehensive reviews). For instance, these interventions have proven effective in reducing severe aggression and self-injurious behavior (e.g., Bird, Dores, Moniz, & Robinson, 1989; Carr & Durand, 1985; Day, Rea, Schussler, Larsen, & Johnson, 1988; Horner et al., 1990), stereotyped and self-stimulatory behaviors (e.g., Durand & Carr, 1987; Wacker et al., 1990), and other aberrant behaviors (e.g., Durand & Crimmins, 1987; Mace &

Lalli, 1991). In addition, research on FCT and FET has investigated the procedures that could increase the effectiveness of functional communication training or functional equivalence training. For example, Horner and Day (1991) demonstrated the central role of response efficiency in functional equivalence training in which socially appropriate behaviors did not compete successfully with the aberrant behaviors of three individuals with severe or profound developmental disabilities until a more efficient alternative behavior was taught. Thus, the researchers suggested that both the efficiency of aberrant behavior and the efficiency of the functionally equivalent alternative behavior should be assessed before functional equivalence training was designed and implemented since the results of this study clearly indicated that dramatic reductions in the aberrant behaviors occurred only when an efficient alternative behavior was taught. More recently, research on FCT has found that the addition of the instruction of tolerance for delayed reinforcement, a self-control training procedure, or an extinction procedure could significantly increase the effectiveness of functional communication training (Fisher et al., 2000; Hagopian et al., 1998; Shirley, Iwata, Kahng, & Mazaleski, 1997).

Although generally positive results have been reported, there are several limitations of functional communication training or functional equivalence training. In FCT or FET studies, for instance, if the results of the functional analysis indicated that a participant's aberrant behavior was maintained by escape from aversive conditions, an appropriate behavior that was usually defined as an alternative request (communication) for escape from difficult task demands would be taught in the subsequent training phase. It is quite possible that the newly trained alternative request can be an effective and efficient method of avoiding difficult instructional situations. Hence, one limitation of FCT and FET studies is that these interventions are effective only when used with aberrant behaviors maintained by positive reinforcement. However, as described earlier, other aberrant behaviors have been shown to be maintained by variables such as sensory reinforcement or escape from demand situations. Several investigators, therefore, have suggested that further research in the area of functional assessment-based interventions should focus on analyzing differential treatment effectiveness with various behavioral functions (Durand & Merges, 2001; Fisher et al., 2000). Thus, one of the purposes of the present study was to develop functional

assessment-based interventions for children whose aberrant behaviors were maintained by different variables. In addition, the effectiveness and generalizability of these interventions would also be investigated.

METHOD

Participants and Setting

Three students with developmental disabilities were chosen to serve as participants for the study because of parental concerns about their chronic and high rates of aberrant behaviors and about their failure to decrease these behaviors even though several home-based teachers had provided services on a regular basis for over one to two years.

Child 1 was a six-year old boy with autism and had a limited vocabulary which was echolalic in nature. He read a few survival words, and could count to 10. He was chosen to participate in the study because of his wide range of severe aberrant behaviors, including severe aggressive, self-injurious, and stereotypic behaviors. His aberrant behaviors had been forceful enough to incur significant tissue damage to his family members and several former home-based teachers, which had made the teachers unwilling to work with him. He presented no significant medical concerns.

Child 2 was a five-year old boy with multiple disabilities. He was nonambulatory and was unable to use his wheelchair independently. He could read his own name when prompted by his parents and had basic self-help skills related to eating and dressing. He was trained to label vocally six objects. He did not request objects or activities independently, but he had basic skills such as imitation of vocal sounds. He had a long history of self-injurious, stereotypic, and aggressive behaviors. Stereotypic behaviors were the participant's dominant aberrant behaviors in the free play settings. He frequently played with toys by himself.

Child 3 was a five-year-old girl diagnosed with severe mental retardation, microcephaly, and seizures. She engaged in multiple forms of aggression, self-injury, and stereotypy. Her aberrant behavior often resulted in bruising or bleeding to herself or others. She spent most of her time lying on the floor. Her verbal behavior was limited to some simple verbal commands and basic responses.

Functional analysis and intervention sessions took place at the participants' homes. In this study, there were two settings: one is the instructional setting and the other is the free play setting. For Child 1, all experimental sessions in the instructional setting took place in a 3 m by 3.5 m room that was usually used for instructional purposes, which contained cabinets, desks, chairs, and shelves. For Child 2, the instructional setting was situated across one-half of the 3.5 m by 4.5 m family room and contained desks, chairs, and instructional materials. For Child 3, all experimental sessions in the instructional setting was conducted in a 2.5 m by 5 m room that was equipped with tables and chairs, and a variety of academic materials. For all three participants, all experimental sessions in the free play setting took place in the living room of their homes.

Response Definitions and Data Collection

The dependent variable was the number per minute of aberrant behaviors emitted during each condition. Aberrant behaviors included aggression, SIB, and stereotypic behavior. Aggression, defined as any behavior that was physically harmful to others, was displayed by Child 1 (kicking and throwing objects at others), Child 2 (hitting others with an open or closed hand and biting other people), and Child 3 (pinching and scratching others). SIB, defined as any behavior that resulted in self-inflicted tissue damage, was display by Child 1 (head banging), Child 2 (face slapping and self-biting), and Child 3 (head hitting). Head banging was defined as contact of the head against furniture, wall, or other stationary environmental objects. Face slapping was defined as contact of any part of hand with the face. Self-biting consisted of contact between upper and lower teeth and the hands, wrists, or forearms. Head hitting was defined as forceful contact of a hand or arm with any part of the head. Stereotypic behavior, defined as any repetitive, noninjurious behavior, was display by Child 1 (hand mouthing), Child 2 (waving hands), and Child 3 (hand flapping). All functional analysis sessions were videotaped with a SONY Video Hi8 Camera Recorder Model CCD-TRV60 which was mounted on the top of shelves or cabinets. Data were collected by the experimenter and a second trained observer viewing videotapes in which running times, in minutes, seconds, and tenths of seconds were automatically burned onto the right hand corner of the films.

Interobserver Agreement

The two trained observers independently but simultaneously observed the

participants for 50% of all functional analysis sessions and recorded the frequency of targeted behaviors. Sessions were 3 minutes in length and were partitioned into 18 10-second intervals to calculate interobserver agreement. Interobserver agreement was calculated for each session by dividing the total number of agreements for the occurrence and non-occurrence of the specified behaviors by the number of agreements plus disagreements and multiplied by 100%. For Child 1, exact agreement coefficients averaged 97.2% for aggression, 98.5% for aggression, and 93.6% for stereotypic behavior. For Child 2, exact agreement coefficients averaged 98.8% for aggression, 97.3% for SIB, and 94.3% for stereotypic behavior. For Child 3, exact agreement coefficients averaged 99.1% for aggression, 93% for aggression, and 92.6% for stereotypic behavior.

PRE-INTERVENTION FUNCTIONAL ANALYSES

Experimental Design and Procedures

A modified functional analysis of aberrant behaviors was conducted prior to the onset of the intervention, in order to empirically identify maintaining contingencies for each participant's aberrant behaviors. Each modified functional analysis consisted of twelve experimental conditions expanded and adapted from those described by Tincani et al. (1999), Sigafoos and Meikle (1996), and Iwata, Dorsey, Slifer, Bauman, and Richman (1994/1982). Three participants were repeatedly exposed to each of twelve different conditions in an alternating treatment design (Barlow & Hersen, 1984). Twelve sessions (one per condition) were conducted each day. Sessions were 3 min. in length and were conducted in a counterbalanced design with random assignment without replacement in order to control for sequence effects.

The experimental conditions of the pre-intervention functional analyses conducted in the present study were designed to simulate contingencies maintaining aberrant behaviors in the participant's natural environments. The functional analysis in the instructional setting was conducted in a room that was usually used for instructional purposes, and included the following six experimental conditions:

Condition 1: Teacher Attention

At the beginning of the session, typical instructional tasks such as coloring,

bead stringing, and puzzle manipulation were presented to the participant by the researcher. The researcher asked the participant to choose a task and said "I'll be right with you." The researcher then turned away from the subject to read a book or complete paperwork. The researcher ignored the participant except to express disapproval (i.e., "Please don't do that") and provide brief physical contact in the form of response interruption and a pat on the back contingent upon the occurrence of aberrant behavior. This condition was designed to simulate a situation in which aberrant behavior is positively reinforced by contingent teacher attention.

Condition 2: Peer Attention

A sibling, the researcher, and the participant were in the same room as the previous condition. Prior to each session, the sibling confederate was instructed that your brother (or sister) has a hard time getting his/her work done, so you need to pay attention to what your brother is doing and say "Please don't do that" to him if you see him do something bad or hurt himself. At the beginning of the session, instructional tasks, which were the same as for the previous condition, were presented to the participant by the researcher. The researcher asked the participant to choose a task and said "I'll be right with you." The researcher then moved toward the door and walked out the door. Contingent on the occurrence of aberrant behavior, the sibling confederate briefly attended to the participant by providing attention in the form of a disapproval (i.e., Please don't do that"). All other responses exhibited by the participant were ignored. Northup, Broussard, Jones, George, Vollmer, and Herring (1995) indicate that peer attention can function as a unique form of positive reinforcement. Thus, this condition was designed to simulate a situation in which aberrant behavior is positively reinforced by contingent peer attention.

Condition 3: Tangible

In this condition, the researcher sat next to the participant and placed preferred items identify by a stimulus preference assessment in clear view but out of the participant's reach. The researcher said "You can have these in a minute". The same typical instructional tasks used during the previous condition were presented to the participant by the researcher. The researcher asked the participant to choose a task. The researcher then ignored the participant except to deliver a preferred item to the participant contingent on the occurrence of

aberrant behavior. The participant was allowed to play with the item for approximately for 20s, after which it was removed to its original placement. No verbal and physical attention was provided from the researcher at any other time during this condition. This condition was design as an analog to instructional situations in which the participant wants an item and is unable to get it. This contingency tested if aberrant behaviors were maintained by positive reinforcement in the form of access to preferred items.

Condition 4: Demand

The researcher sat next to the participant and typical academic tasks (i.e., matching shapes or colors, sorting objects) were presented in discrete trial format. The academic tasks were selected on the basis of previous data indicating that the participant was unable to complete independently due to the level of difficulty. The academic tasks were presented continuously at a stable rate throughout the condition, using vocal verbal prompts, and least to most intrusive physical prompts as needed for task completion. Contingent on the occurrence of aberrant behavior, the researcher removed the instructional materials and turned away from and ignored the participant for 60 seconds. If no aberrant behavior occurred during the 60 second period, the next trial was initiated. Social praise was delivered upon completion of each task, regardless of the prompt level needed to complete the task. This condition was design as an analog to situations in which the participant may be motivated to escape difficult instructions. This contingency tested if aberrant behaviors were maintained by negative reinforcement in the form of escape from task demands.

Condition 5: Play

A sibling, the researcher, and the participant were seated at a desk in the same room as the previous condition. The participant was given preferred stimuli and the researcher and the sibling engaged the participant in structured play throughout the session. Engagement involved invitations to play with various preferred toys, conversation related to play activities, passing toys back and forth, and occasional social praise and brief physical contact contingent upon appropriate play responses at least once every 30 seconds. No instructions or academic tasks were presented to the participant. All instances of aberrant behaviors were ignored. This condition simulated an enriched environment and served as a control condition for the other conditions, free of demands and

enriched with adult and peer attention, praise and reinforcing activities.

Condition 6: Alone

The participant was alone in the same room as the previous condition. The room contained no extraneous materials other than furniture. This condition simulated a barren environment and served to identify those occurrences of aberrant behaviors possibly maintained by automatic reinforcement or sensory stimulation.

The functional analysis in the free play setting included the following six experimental conditions:

Condition 7: Adult Attention

The participant was seated in his free play area, where a variety of leisure materials within his reach were available. The participant was instructed that this was his time to play, and he could engage freely in activities and move about the room. The researcher and a parent then sat in a corner of the room reading books or magazines. Contingent on the occurrence of aberrant behavior, adult attention in the form of a disapproval (i.e., "Please don't do that") and physical contact (i.e., patting the participant's back and blocking the response) were given to the participant. All other responses exhibited by the participant were ignored. This condition was designed to approximate one type of reinforcement contingency in the free play setting that might maintain aberrant behavior; that is, aberrant behavior often produces much attention from caregivers, while appropriate behavior receives relatively little attention.

Condition 8: Divided Attention

At the beginning of the session, the researcher said "Your mother and I have something to talk about and this is your time to play." While the researcher talked with the participant's mother about instruction programming, the researcher and the parent ignored the participant except to express disapproval and provide brief physical contact in a manner identical to that described in the previous condition. This condition represented naturally occurring situations in which adults are engaged in activities which divert their attention away from a child.

Condition 9: Peer Attention

Prior to this session, the sibling confederate was instructed that your brother/sister sometimes does something bad while he is playing, so you need to pay attention to what he/she is doing, and say "Please don't do that" to him if you

see him do something bad or hurt himself. At the beginning of the session, the participant was instructed that this was his time to play, and he could engage freely in activities and move about the room. The researcher then walked out the door. Contingent on the occurrence of aberrant behavior, the sibling confederate briefly attended to the participant by providing attention in the form of disapproval (i.e., Please don't do that"). All other responses emitted by the participant were ignored. This condition was designed to simulate the participant's free play situation in which only the participant and his sibling(s) were in a play area. Direct observations conducted prior to the functional analyses indicated that siblings interacted minimally with the participants except for disapproving comments during episodes of aberrant behavior.

Condition 10: Tangible

The free play area contained those items previously identified by a stimulus preference assessment as preferred by the participant. The researcher began the session by offering the preferred items or activities to the participant's sibling in front of the participant. Contingent on the occurrence of aberrant behavior, the researcher responded to the behavior by allowing the participant access to the activity or item being offered the participant's sibling. No verbal and physical attention was provided from the researcher and the sibling at any other time during this condition. This condition was design as an analog to typical free play situations in which the participant wants an item or wants to participate in an activity and is unable to get it.

Condition 11: Unstructured Play

The participant was allowed to engage in isolate or cooperative play with the sibling, the parent, or the researcher, or move freely about the room. The researcher periodically presented preferred toys to the participant. Contingent on appropriate behavior, the researcher delivered social praise and brief physical contact. No demands or tasks were presented to the participant. All instances of aberrant behaviors were ignored. This condition served as a control procedure for the presence of a sibling, a parent, and a researcher, the availability of preferred items and activities, the absence of demands, the delivery of social approval for appropriate behavior, and the lack of approval for aberrant behavior.

Condition 12: Alone

The participant was instructed that this was his time to play. The researcher

then left the room and had no further interaction or contact with the participant. In the room, no specific tasks or activities were directly provided to the participant.

Results

Figure 1 shows the results of the functional analysis in the instructional setting for Child 1. Data indicated that the rates of aberrant responses were highest during the demand condition (mean = 4.33; range, 4.2 to 4.5), thus they were maintained primarily by social-negative reinforcement. The teacher attention condition produced the next highest rates (mean = 2.87; range, 2.8 to 2.9), with indications of an increasing trend across sessions. Figure 2 shows the results of the functional analysis in the free play setting for Child 1. Data indicated that the rates of aberrant responses were highest during the adult attention condition (mean = 4.13; range, 3.9 to 4.3), thus the aberrant behaviors occurred in the free play setting were maintained primarily by social-positive reinforcement in the form of contingent adult attention. The peer attention condition produced the next highest rates (mean = 3.27; range, 3.1 to 3.4), with indications of an increasing trend across sessions.

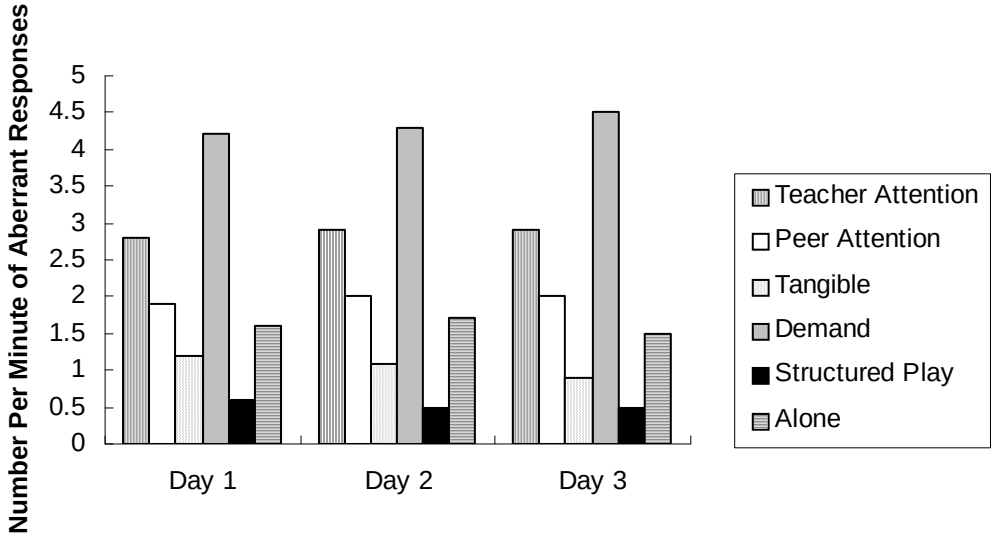

Figure 1. Functional Analysis in an Instructional Setting for Child 1

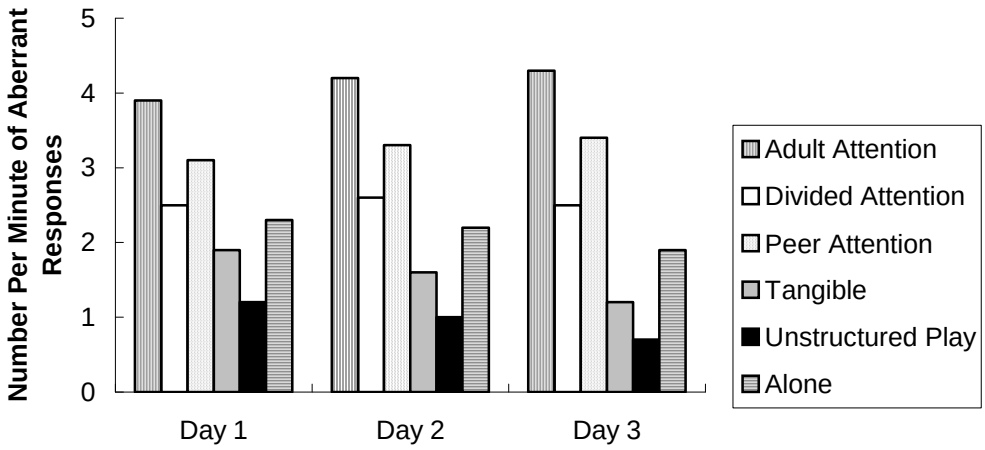

Figure 2. Functional Analysis in a Free Play Setting for Child 2

Figure 3 shows the results of the functional analysis in the instructional setting for Child 2. Data indicated that the rates of aberrant responses were highest during the teacher attention condition (mean = 5.03; range, 4.8 to 5.3) with indications of an increasing trend across sessions, thus they were maintained primarily by social- positive reinforcement in the form of contingent adult attention. The peer attention condition produced the next highest rates (mean = 3.17; range, 3.1 to 3.2). Figure 4 shows the results of the functional analysis in the free play setting for Child 2. Data indicated that the rates of aberrant responses were highest during the peer attention condition (mean = 4.07; range, 3.9 to 4.2), thus the aberrant behaviors occurred in the free play setting were maintained primarily by social-positive reinforcement in the form of contingent peer attention. The adult attention condition produced the next highest rates (mean = 2.43; range, 2.3 to 2.6), with no apparent substantial trends.

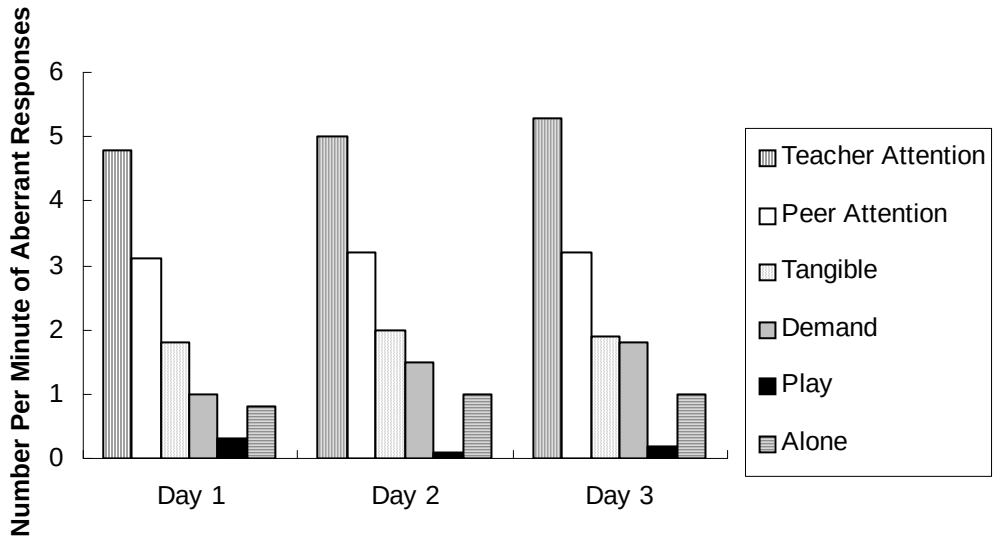

Figure 3. Functional Analysis in an Instructional Setting for Child 2

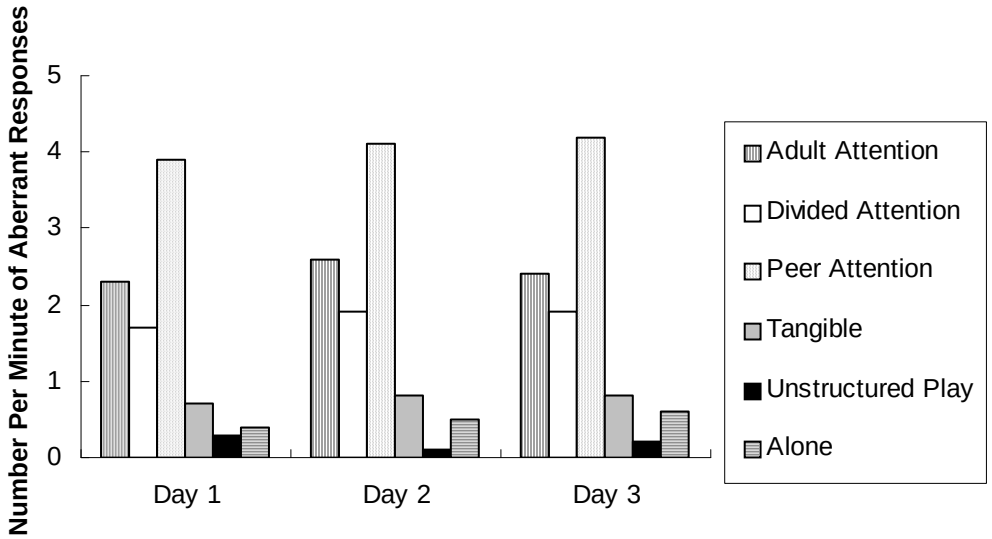

Figure 4. Functional Analysis in a Free Play Setting for Child 2

Figure 5 shows the results of the functional analysis in the instructional

setting for Child 3. Data indicated that the rates of aberrant responses were highest during the alone condition (mean = 3.3; range, 3.2 to 3.5). During the alone condition, in which access to alternative sources of stimulation or reinforcement was minimized, aberrant behavior functioned as a "choice" behavior for Student C in an "impoverished" or "austere" (Horner, 1980) environment. That is, the data indicated that Student C's aberrant behavior was maintained primarily by automatic reinforcement. The teacher attention condition produced the next highest rates (mean = 1.57; range, 1.5 to1.6). Figure 6 shows the results of the functional analysis in the free play setting for Child 3. Data indicated that the rates of aberrant responses were highest during the alone condition (mean = 3.57; range, 3.5 to 3.7), thus the aberrant behaviors occurred in the free play setting were maintained primarily by automatic reinforcement. The peer attention condition produced the next highest rates (mean = 1.7; range, 1.6 to 1.8), with no apparent substantial trends.

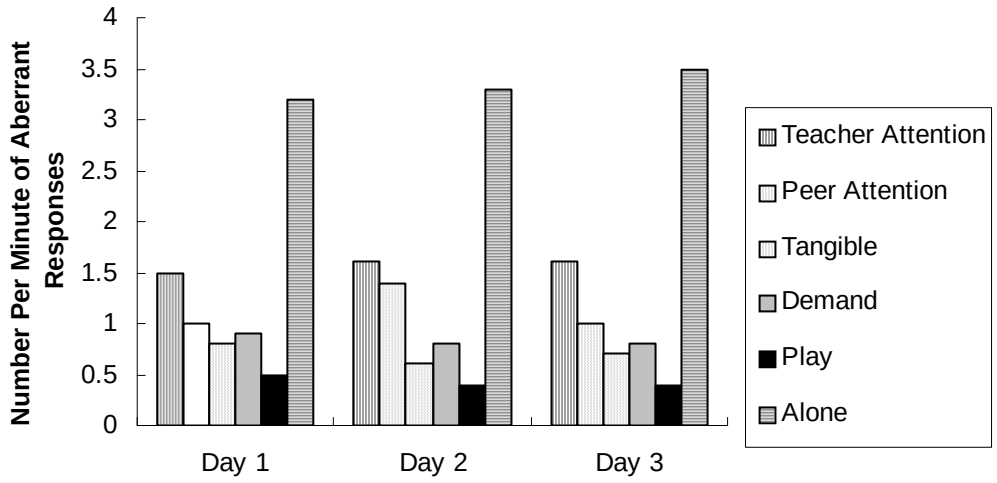

Figure 5. Functional Analysis in an Instructional Setting for Child 3

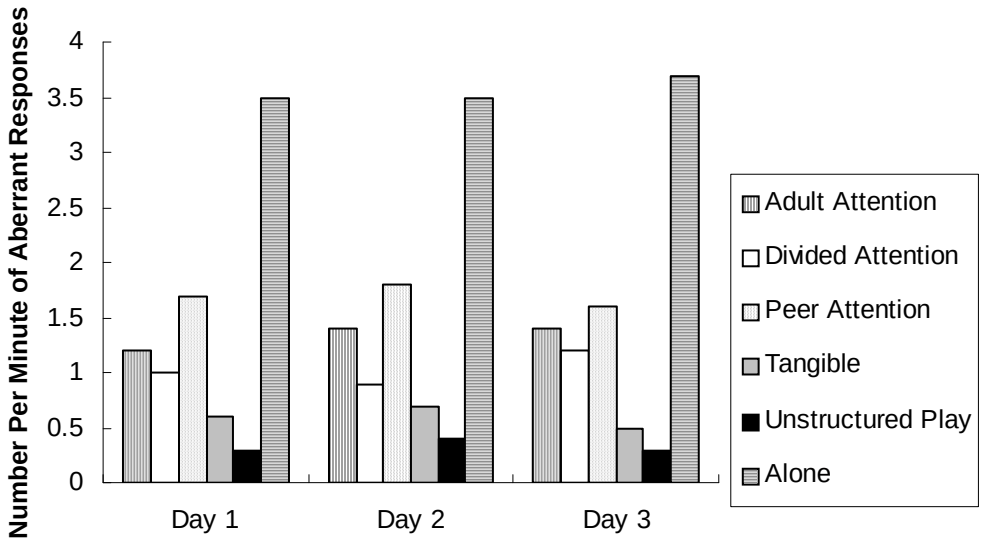

Figure 6. Functional Analysis in a Free Play Setting for Child 3

ASSESSMENT-BASED INTERVENTIONS

Response Definitions and Data Collection

Two classes of response were measured: 1) the number per minute of appropriate behaviors during sessions and 2) the number per minute of aberrant behaviors emitted during sessions. Appropriate behaviors included communicative behavior that was defined individually as a coherent utterance of a specified vocalization or other appropriate behavior such as being on task or interacting with siblings, parents, and teachers during play. For Child 1, his appropriate responses were defined as (a) saying "help please"; (b) saying "teacher"; (c) saying "mama"; (d) saying "brother"; (e) being on task during work activity, and (f) interacting with siblings, parents, and teachers during play. For Child 2, his appropriate responses were defined as (a) saying "teacher"; (b) saying "sister"; (c) saying "mama"; (d) being on task during work activity, and (e) interacting with siblings, parents, and teachers during play. For Child 3, her appropriate responses were defined as (a) actively engaging with a preferred

activity; (b) saying “teacher”; (c) saying “sister”; (d) being on task during work activity, and (e) interacting with siblings, parents, and teachers during play. The operational definitions of the aberrant behaviors of each participant are identical to those described in the pre-intervention functional analyses. All instructional and free play sessions were videotaped, and two independent observers recorded the frequency or duration of targeted behaviors. Sessions were 10 minutes in length and were partitioned into 60 10-second intervals to calculate interobserver agreement.

Interobserver Agreement

The researcher and the second trained observer independently and separately collected data for each participant for 50% of all free play periods and intervention sessions, evenly distributed across experimental phases. Interobserver agreement was calculated for each session by dividing the total number of agreements for the occurrence and non-occurrence of the specified behaviors by the number of agreements plus disagreements and multiplied by 100%. An agreement was defined as both observers recording exactly the same frequency or duration of a target response in a given 10-second interval. Mean interobserver agreement for aberrant behaviors were 93.9%, 97.2%, and 95.8% for Child 1, 2, and 3, respectively. Average interobserver agreement for appropriate behaviors were 96.1%, 92.3%, and 91.7% for Child 1, 2, and 3, respectively.

Experimental Design and Procedures

The interventions for the three participants were analyzed with an ABAB’ reversal design. There were four phases in this experiment: 1) Baseline; 2) Intervention I; 3) Return to Baseline; and, 4) Intervention II. Baseline and intervention sessions lasted 10 min, and each of the phases was described in detail below.

Baseline

First, ten-minute baseline sessions were conducted in the instructional setting. The participant was seated with siblings at one of four desks, which were facing and adjacent to each other. A variety of preferred toys were placed on the desks. The experimenter sat next to the student; however, no instruction was conducted during this phase. Subsequently, the target participant was observed for 10 min. in free play setting. No programmed consequence for aberrant behavior was used in this condition.

Intervention I

For Child 1, the results of the functional analysis in the instructional setting indicated that aberrant behaviors were maintained primarily by escape, and to a lesser extent by teacher attention. The functional communication training procedures recommended by Fisher and colleagues (1993) were applied. Two alternative socially acceptable behaviors (saying “help please” and “teacher”) were taught. The child was prompted when he arrived at a step in the task that had been difficult previously or when he wanted to elicit teacher attention. An errorless backward chaining procedure was used to train the participant to emit a communicative response to access the relevant reinforcer (escape or teacher attention). This procedure continued until the participant independently performed with 90% accuracy across two successive sessions. In addition, the prompt hierarchy procedure was used to prevent the newly trained alternative request not to attenuate or alleviate instructional demands. The instructional activities selected were task analyzed. If the participant did not perform correctly, a gesture, model, vocal, physical guidance prompt sequence was followed until a correct response occurred. Hence, the phrase “help please” would serve to prompt a teacher to reduce the difficulty of the task, and would not become an effective method of avoiding difficult instructional situations.

For Child 2, the results of the functional analysis in the instructional setting indicated that aberrant behaviors were maintained by social- positive reinforcement in the form of contingent teacher attention and also peer attention. Two alternative socially acceptable behaviors (saying “teacher” and “sister”) were taught. The functional communication training procedures described above were applied.

For Child 3, the results of the functional analysis in the instructional setting indicated that aberrant behaviors were maintained primarily by automatic reinforcement, and to a lesser extent by teacher attention. Prior to initiating each intervention session, a stimulus preference assessment procedure was used, which allowed the participant to selected preferred stimuli for that session. Intervention I condition for Child 3 was an enriched environment with preferred stimuli. Noncontingent reinforcement, consisting of continuous and free access to the preferred stimuli in the enriched environment, was applied to the participant. In addition, the functional communication training procedures were applied to teach

two alternative socially acceptable behaviors (clapping, which produced attention, and saying “teacher”). The clapping behavior would be faded with the participant’s increased success with saying “teacher”. For all of the participants, the generalization data were collected in the subsequent 10 min. free play session.

Intervention II

With the implementation of Intervention I procedures, the aberrant behaviors of all participants decreased; however, their aberrant behaviors still not decreased to near-zero levels. Hence, the results of the functional analysis in the free play setting were incorporated in order to develop more effective and generalizable interventions. For Child 1 and 2, the results of the functional analysis in the free play setting indicated that aberrant behaviors were maintained primarily by adult attention, and to a lesser extent by peer attention. The functional communication training procedures described in the Intervention I were used to teach two alternative socially acceptable behaviors (saying “mama” and “brother” for Child 1, and saying ““mama” and “sister” for Child 2). For Child 3, the results of the functional analysis in the free play setting indicated that aberrant behaviors were maintained primarily by automatic reinforcement, and to a lesser extent by peer attention. Thus, the child was provided with continuous access to the preferred stimuli during free play sessions. In addition, the functional communication training procedures were used to teach an alternative socially acceptable behavior (saying “sister”). For all of the three participants, the individual Intervention I procedures would also be included and reviewed in the Intervention II phase.

RESULTS

Figures 7 and 8 show the number per minute of appropriate behaviors and aberrant behaviors emitted by Child 1 during 10 min. intervention and free play sessions for each phase, respectively. During Baseline, appropriate behaviors occurred at a consistently very low and stable rate. As shown in Figures 7 and 8, Child 1's appropriate behaviors ranged from 0 to 0.1 with a mean rate of 0.04 in the instructional setting, whereas his appropriate behaviors ranged from 0 to 0.2 with a mean rate of 0.1 in the free play setting. The mean rate of aberrant behaviors in the same phase (Baseline) for Child 1 was 5.92 per session with a range of 5.8 to 6.1 in the instructional setting, whereas his aberrant behaviors

ranged from 5 to 5.6 with a mean rate of 5.26 in the free play setting. For Child 1, an increase in rate of appropriate behaviors and a reduction in rate of aberrant behaviors corresponded with the start of the Intervention I phase. The rate of appropriate behaviors ranged from 0.7 to 4.3 with an ascending trend and a mean rate of 2.56, whereas the rate of aberrant behaviors ranged from 0.5 to 3.2 with a descending trend and a mean of 1.83 in the instructional setting. The rate of appropriate behaviors ranged from 0.7 to 4.2 with an ascending trend and a mean rate of 2.07, whereas the rate of aberrant behaviors ranged from 0.4 to 2.9 with a descending trend and a mean of 1.96 in the free play setting. In the return to Baseline the mean rate of appropriate behaviors was 3.56 (range = 2.2 to 4.3), and the mean rate of aberrant behaviors increased to 2.12 (range = 1.8 to 2.3) in the instructional setting. The mean rate of appropriate behaviors reduced to 2.48 (range = 1.9 to 3.2), and the mean rate of aberrant behaviors was 1.76 (range = 1.6 to 2) in the free play setting. A significant increase in rate of appropriate behaviors and a substantial reduction in rate of aberrant behaviors corresponded with the start of the Intervention II phase. The rate of appropriate behaviors ranged from 3.4 to 4.8 with a mean rate of 3.99, while the mean rate of aberrant behaviors ranged from 0.3 to 2.3 with a mean of 1.52 in the instructional setting. The rate of appropriate behaviors ranged from 2.8 to 4.7 with a mean rate of 3.7, while the mean rate of aberrant behaviors ranged from 0.1 to 1.2 with a mean of 0.7 in the free play setting.

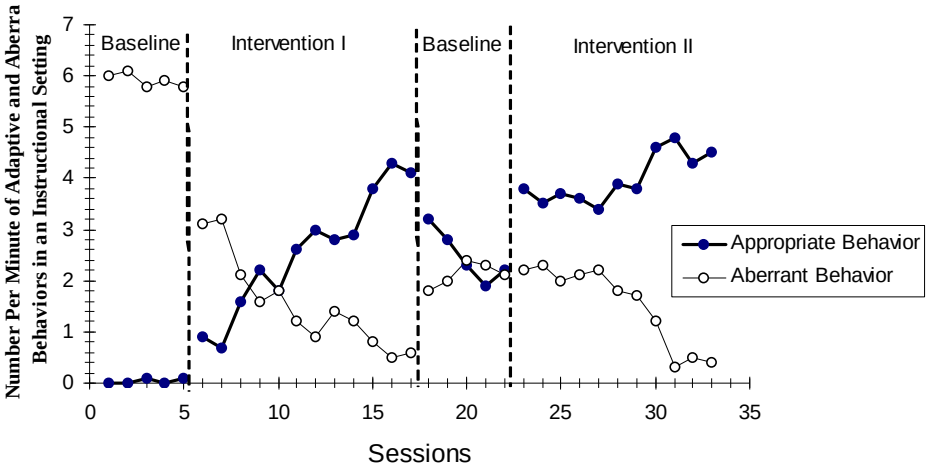

Figure 7. Number Per Minute of Adaptive and Aberrant Behaviors for Child1 in an Instructional Setting Across Each Experimental Phase

Figures 9 and 10 show the number per minute of appropriate behaviors and aberrant behaviors emitted by Child 2 during 10 min. intervention and free play sessions for each phase, respectively. Figures 9 and 10 indicated that Intervention I reduced Child 2's aberrant behaviors from mean baseline levels of 4.38 and 3.9 to levels of 2.43 and 2.28, respectively. Intervention I increased Child 2's appropriate behaviors from mean baseline levels of 0.12 and 0.14 to levels of 2.36 and 2.18, respectively. Aberrant behaviors were much lower during Intervention II (M = 1.44; range, 0.2 to 2.6 in the instructional setting; M = 0.7; range, 0 to 2.1 in the free play setting). The mean rate of appropriate behaviors was higher during Intervention II (M = 3.17; range, 1.9 to 4.9 in the instructional setting; M = 3.53; range, 2.5 to 4.3 in the free play setting) than during Intervention I (M = 2.36; range, 0.6 to 4.2 in the instructional setting; M = 2.18; range, 0.7 to 3.9 in the free play setting).

Figures 11 and 12 show the number per minute of appropriate behaviors and aberrant behaviors emitted by Child 3 during 10 min. intervention and free play sessions for each phase, respectively. Figures 11 and 12 indicated that Intervention I reduced Child 3's aberrant behaviors from mean baseline levels of 3.46 and 3.32 to levels of 1.9 and 1.79, respectively. Intervention I increased

Child 3's appropriate behaviors from mean baseline levels of 0.1 and 0.16 to levels of 2.23and 2.26, respectively. Aberrant behaviors were lower during Intervention II (M = 1.12; range, 0.3 to 2.1 in the instructional setting; M = 1.51; range, 0.4 to 2.4 in the free play setting). The mean rate of appropriate behaviors was higher during Intervention II (M = 2.99; range, 2 to 4.1 in the instructional setting; M = 2.73; range, 1.9 to 3.9 in the free play setting) than during Intervention I (M = 2.23; range, 0.7 to 3.6 in the instructional setting; M = 2. 26; range, 0.9 to 3.6 in the free play setting).

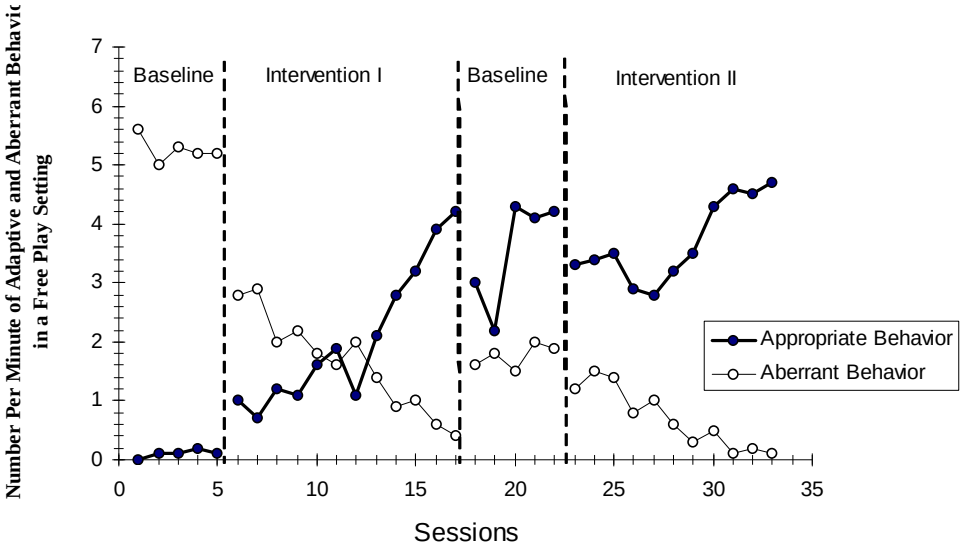

Figure 8. Number Per Minute of Adaptive and Aberrant Behaviors for Child1 in a Free Play Setting Across Each Experimental Phase

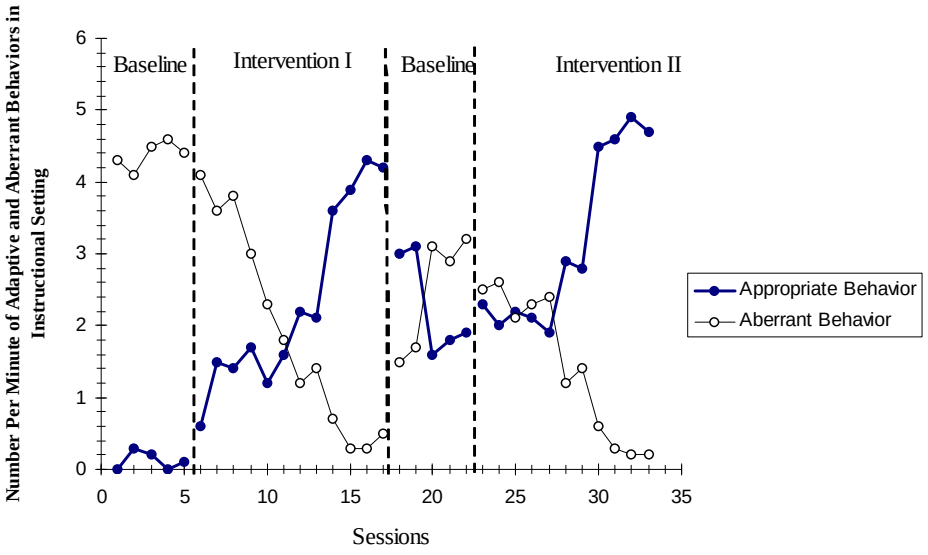

Figure 9. Number Per Minute of Adaptive and Aberrant Behaviors for Child 2 in an Instructional Setting Across Each Experimental Phase

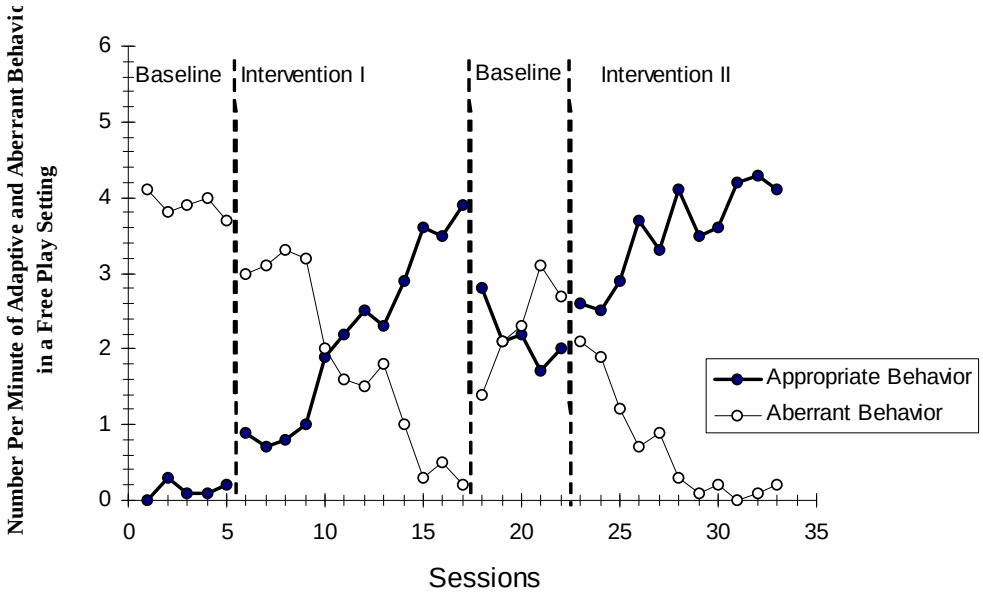

Figure 10. Number Per Minute of Adaptive and Aberrant Behaviors for Child 2 in a Free Play Setting Across Each Experimental Phase

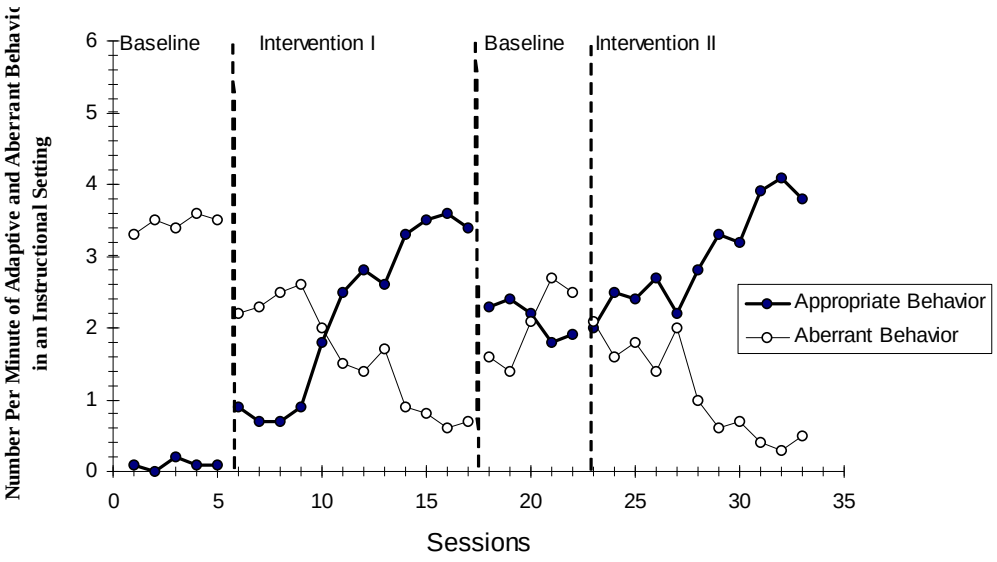

Figure 11. Number Per Minute of Adaptive and Aberrant Behaviors for Child 3 in an Instructional Setting Across Each Experimental phase

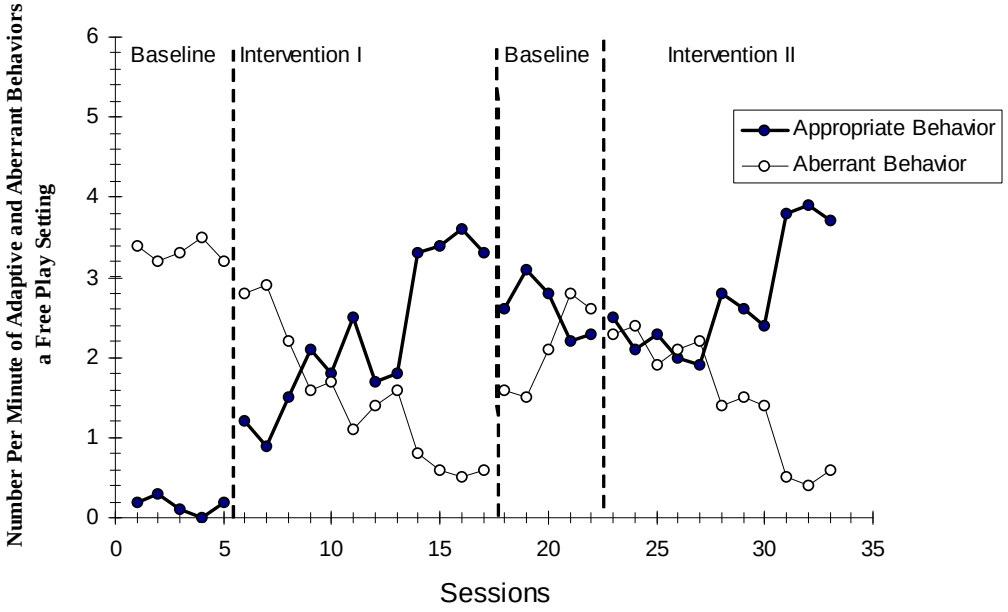

Figure 12. Number Per Minute of Adaptive and Aberrant Behaviors for Child

3 in a Free Play Setting Across Each Experimental Phase

DISCUSSION

The results of the pre-intervention functional analyses suggest that the three participants' aberrant behaviors were maintained by different controlling variables in the instructional settings and free play settings. That is, there is situation specificity in behavioral function. The present modified functional analyses advance the current literature by demonstrating the situation specificity of behavioral function in different settings; that is, the application of the functional analyses is not limited to controlled settings, and it also can be used to analyze the maintaining variables of aberrant behavior in the natural environment. This may be particularly appealing to parents and teachers since the modified brief functional analyses can easily be incorporated into natural family and classroom routines.

Researchers have stressed the need to extend the current functional analysis to examine other possible functions of aberrant behaviors and to meet the range of situations faced in applied settings (Carr, 1994; Conroy, et al., 1996; Cunningham & O'Neill, 2000; Sugai, Sprague, & Horner, 1999). The present study has developed a more refined variation of the functional analysis technique, and the results of the pre-intervention functional analyses suggest that for all three participants, aberrant behaviors were sensitive to the twelve reinforcement contingencies in different settings assessed during modified brief functional analyses. The data from the 6 modified functional analyses of the maintaining conditions of aberrant behaviors demonstrated the efficacy of the functional analysis methodology.

It is important to note that most aberrant behaviors that occurred with decreasing rates corresponded to increasingly higher rates of appropriate behaviors and vice versa. A statistical analysis of each set of the data from the experiment demonstrated that a strong negative correlation (range= -.85 to -.98) existed between rates of appropriate behaviors and rates of aberrant behavior. Person's r(s) suggest that as appropriate behaviors increased, there was a corresponding decrease in their aberrant behavior, and vice versa. There are at least two interrelated plausible explanations for such an inverse relationship.

The first explanation involves Kazdin's (1982) supposition that a functional

relationship within a group of topographically dissimilar behaviors may be observed to covary inversely even though intervention is not directly applied to the responses. This phenomenon, known as response covariation, is the observation that two or more behaviors vary inversely or directly (Kazdin, 1982). Thus, the inverse relationship between appropriate behavior and aberrant behavior observed in the experiment may represent a form of response covariation. Research on response covariation (e.g., Parrish, Cataldo, Kolko, Neef, & Egel, 1986) have demonstrated convincingly that adaptive behaviors such as prosocial communicative responses or compliance and problem behaviors may form an inverse response class. In addition, the applied literature regarding response covariation is replete with examples of increases and decreases of untreated or nontarget behaviors resulting from increases in reinforcement relative to increases in target behaviors. Several studies have shown that procedures that increase adaptive behavior often result in unplanned collateral reductions in aberrant behavior. For example, Mace and Belfiore (1990) reported that increases in compliant responses were accompanied by collateral reductions in the stereotypic behavior of a woman with severe mental retardation. However, Parrish and Roberts (1993) pointed out that although the robustness of the phenomenon of response covariation has been demonstrated in highly structured environments, very little is known about the process of response covariation under natural conditions. The researchers indicated that the lack of empirical research on this topic have created a need for systematic replications in less structured settings such as homes. Thus, the results of the present experiment are important because they extend the current literature base by documenting the existence of such a phenomenon in a free play setting of the participants' homes.

Second, corollary aberrant behaviors can be viewed as "choice behaviors", or the rate of those behaviors which occur as "extraneous responses". An individual can be said to have a "choice" of responding to the task at hand. For example, in the case of behavior disorders, the individual may choose to engage in aberrant behavior rather than adaptive behavior. Hence, during the functional communication training and functional equivalence training, when the natural results of effective communicative and appropriate behaviors began more and more to function to reinforce the participants; that is, reinforcements were denser for effective communicative and appropriate behaviors, effective communicative

and appropriate behaviors increased resulting in decreased aberrant behavior.

As suggested by the results of the pre-intervention functional analyses, the aberrant behaviors provided reinforcement functions for the students, and if the reinforcement/response conditions can be substituted by communicative and appropriate behaviors, the aberrant behaviors lose much of their utility. Maybe because the aberrant behaviors and the target communicative and appropriate behaviors trained in the Intervention I and II phases are functionally equivalent, the reinforcement schedule for the target behaviors was the 'richer' of the two schedules, thus resulting in increased appropriate behaviors and decreased aberrant behaviors. Effective communicative and appropriate behavior became a more efficient avenue for reinforcement.

The results of the experiment indicated that for all three subjects, the functional assessment-based interventions were significantly effective and efficient in reducing rates of aberrant behavior. It is important to note that no functional assessment model is effective unless it leads to a significant reduction of aberrant behavior through intervention. The results of the experiment demonstrated that the assessment-based interventions derived from a more refined variation of the functional analysis methodology could reduce aberrant behavior not only in the instructional settings but also in the free play settings. The generalization of the intervention gains to a new setting can be attributed to the introduction of natural maintaining contingencies (Stokes & Baer, 1977). Since the trained appropriate and communicative behaviors could produce useful and consistent social reinforcement in nontraining sessions and the aberrant behavior was no longer as effective, the appropriate or communicative behavior was strengthened and weakened the aberrant behavior. This may be able to explain in part why the functional communication training and functional equivalence training could facilitate the generalization in new settings.

Future investigations might further assess maintenance of these results across different individuals over long periods of time. As suggested by the literature (e.g., Forness & Kavale, 2001) and the results of this study, there may be a value to incorporate the findings of biochemical studies in the analysis of variables maintaining aberrant behavior. It may contribute to the understanding of the functions of aberrant behavior, and thus additional behavioral and psychopharmacologic treatments could be developed to eliminate the aberrant

behavior of individuals with developmental disabilities and to increase the likelihood that appropriate behavior will maintain during periods of nonreinforcement.

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發展性障礙兒童異常行為之功能分析與介入策略之實驗研究

朱慧娟*

摘　要

本研究旨在發展不同情境模式之功能分析法在瞭解發展性障礙兒童異常行為發生原因的可行性，並進一步探討根據不同情境模式之功能分析結果所研擬之介入策略對改善發展性障礙兒童異常行為與增進適當行為的成效。

研究對象為三位發展性障礙兒童。本研究分為功能分析與實驗處理二階段。於功能分析階段，實驗設計採單一受試實驗設計法中的交替處理設計。首先以研究者所發展的功能分析法，評量每一受試者在教學與自由活動情境中異常行為發生的可能原因，即實際觀察每一位兒童在十二種不同實驗情境下異常行為發生的情形，並分析所得之實徵數據，以找出引起或維持異常行為的原因。於實驗處理

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階段，實驗設計採單一受試實驗設計法中的倒返設計，此階段運用不同情境模式之個別功能分析結果所研擬之處理策略，進行介入，以瞭解其對增進發展性障礙兒童適當行為與改善異常行為之發生率的成效。

研究結果發現，此種功能分析法能有效分析發展性障礙兒童於不同情境中之異常行為的功能，且依個別功能分析結果所研擬之介入方案的實施，均能顯著降低所有樣本在教學與自由活動情境中的異常行為並顯著增進其適應行為。本研究的發現可作為精緻功能分析方法論之依據，並有助於對發展性障礙兒童異常行為於不同情境中所具之功能有更進一步瞭解，且可提供特教教師在評量發展性障礙兒童異常行為與設計有效之介入方案時之參考。

關鍵詞：功能分析、發展性障礙、異常行為、介入策略