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FUNCTIONAL ANALYSIS AND TREATMENT OF STEREOTYPICAL BEHAVIOR IN A CHILD WITH MULTIPLE DISABILITIES IN TENNESSEE, USA

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The current study included four experiments that functionally analyzed stereotypical behavior. An analogue functional analysis was used in Experiment 1 to detect the function of one student' s stereotypy which might serve to escape from task demands, obtain attention from others, or produce sensory self-stimulation. An analysis of sensory modalities was conducted in Experiment 2 to further analyze the possible sensory consequences causing the student's stereotypy. Alternative sensory reinforcers were used in Experiment 3 to compete with specific sensory consequences maintaining the student's stereotypy. Finally, functional communication training (FCT) developed from prior functional analyses was used in Experiment 4 to test specific hypotheses regarding the operant functions of stereotypical behavior for the student. Results of the present study demonstrated sensory reinforcement was a determinant of stereotypical behavior in this student. The specific function of stereotypy in this student was maintained by visual stimulation. Moreover, FCT could be successfully taught to decrease the student's stereotypical responses.

Key words: multiple disability, stereotypical behavior, functional analysis

Abnormally high rates of stereotypic behavior are often found in persons with mental retardation, autism, or related severe disabilities. This aberrant behavior might affect learning activities if it exhibited at high rates (Koegel & Covert, 1972). Additionally,it might inversely relate to social integration in more inclusive settings (Durand & Carr, 1987). Therefore, detecting the causes of stereotypy and reducing this aberrant behavior becomes an important issue. Previous studies have revealed that many variables, such as demographic and environmental variables, might be relevant to the occurrence of stereotypical behavior (e.g., Berkson & Mason, 1963; Chock & Glahn, 1983). However,

little is known regarding the functions of these variables. On the other hand, despite a variety of behavioral techniques being used to reduce stereotypy in studies between 1960 and 1980 (LaGrow & Repp, 1984), little attention was paid to the functions of stereotypy. Therefore, the effects of treatments have been inconsistent (Lovaas, Newsom, & Hickman, 1987). Further exploration to examine the functions that might exert their control over stereotypy is needed.

The origin and functions of stereotypical behaviors remains unclear. Contemporary researchers found that stereotypy may be maintained by operant functions (Durand & Carr, 1987; Mace & Belfiore, 1990). Behavioral analysis further posits that stereotypies are maintained by positive and negative social and/or sensory reinforcement (Kennedy, Meyer, Knowles, & Shukla, in press; Sprague, Holland, & Thomas, 1997).

SENSORY REINFORCEMENT

It was initially assumed that this behavior was maintained by sensory consequences (Lovaas et al., 1987). If stereotypy occurs with and without task demands, across most settings (Rincover, Peoples, & Packard, 1979), and has no observable antecedents or consequences (Devany & Rincover, 1982), this suggests sensory reinforcement. This hypothesis postulates that repetitive behaviors function to modulate sensory input to an individual when the environment lacks or provides too much stimulation. Support for this position can be found in Rincover's (1978) study. He demonstrated that subjects' stereotypical behaviors could be maintained by different sensory consequences. One subject's plate spinning stereotypy was eliminated when the table was carpeted to eliminate auditory consequences. The proprioceptive feedback was masked by taping a vibrator to the back of the second subject's hand, and finger flapping was reduced. When the proprioceptive feedback was masked through vibration, the third subject's object twirling was significantly decreased. These results have been supported by subsequent studies (Rincover et al., 1979; Devany & Rincover, 1982). Recent studies used analogue functional analyses (Iwata et al., 1994) to simulate a lack of environmental stimulation. If environments occasion people engaging in stereotypy, individuals might exhibit high incidences of stereotypy in alone conditions either because of negative reinforcement (i.e., lowered levels of stimulation) or to self-stimulate themselves (positive reinforcement) owing to understimulation in the environment. Some researchers have proposed these functions (Applegate, Matson, & Cherry, 1999; Mason & Iwata, 1990; Sturmey, Carlsen, Crisp, & Newton, 1988; Wehmeyer, Bourland, & Ingram, 1993).

Although sensory consequences may contribute to the maintenance of stereotypic responses, it still lacks robust evidence to conclude that these stimuli can be responsible for the development of the stereotypy due to difficulties in measuring these events (Kennedy, 1994). It is difficult to declare that

stereotypy is maintained by sensory consequences unless the consequence can be systematically manipulated to demonstrate its relation to this behavior.

Negative Social Reinforcement

Stereotypical behaviors may be maintained by negative reinforcers involving escape or avoidance of noxious social stimuli (Durand & Carr, 1987; Sturmey et al., 1988; Mace & Belfiore, 1990). This viewpoint posits that individuals might exhibit high rates of stereotypy to escape from demands or noxious settings.

Although some individuals' stereotypical behaviors could be emitted to escape noxious stimuli, others might function for other reinforcers (Repp, Felce, & Barton, 1988). Similarly, Applegate et al. (1999) found that stereotypies were maintained by nonsocial consequences, such as alone conditions and self-stimulation, rather than an escape from the task demand.

Positive Social Reinforcement

Stereotypical behaviors may be maintained by positive reinforcers involving attention or tangible items from others (Dadds, Schwartz, Adams, & Rose, 1988; Thompson & Berkson, 1985; Frea & Hughes, 1997). This positive reinforcement perspective hypothesizes that individuals might exhibit high levels of stereotypy to obtain attention or favored items from others.

Contrary to this view, Repp et al. (1988), in a study with 2 students with severe mental retardation who exhibited stereotypic responding, found that stereotypyies were maintained by self-stimulation rather than positive reinforcers, such as attention from staff. Other studies have shown that some individuals rarely exhibit stereotypy to gain attention (e.g., Sturmey et al., 1988). These inconsistent findings suggest that the functions maintaining stereotypy are so complex that no single study has thoroughly detected all its functions. Further studies conducted in comparison with a variety of attention and other variables are needed.

Multiply Determined Stereotypy

Despite considerable research and a number of hypotheses, such as self-stimulation (positive and/or negative sensory reinforcement), positive social reinforcement, and negative social reinforcement, no conclusions apply to all individuals who emit stereotypy. This suggests that the functional control of stereotypy might be multiple and complex (Kennedy et al., in press; Sprague et al., 1997). One single factor may not account for all causes of stereotypy. Stereotypy might be maintained by positive sensory reinforcement or negative sensory reinforcement, respectively, in some individuals with mental retardation, but for other cases, positive social reinforcement or negative social reinforcement might reasonably account for its causes.

PURPOSE OF THE STUDY

The first purpose of this study was to examine possible functions of one student's stereotypy maintained mainly by positive and/or negative social reinforcement, and/or sensory reinforcement. Analogue functional analyses were used in Experiment 1 to detect stereotypy which served as escape from task demand, obtaining attention from the investi-

gator, and producing self-stimulation.

Second, if the functions for the student's stereotypy were maintained by sensory consequences, this study would seek to expand the field's current ability to identify specific sensory reinforcers that maintain stereotypy. To conduct experimental analyses of possible visual, auditory, or tactile sensory consequences that might maintain stereotypy, functional analyses in Experiment 2 were used to mask the possible sensory consequences causing stereotypy.

Third, if specific sensory consequence maintained stereotypy could be marked to demonstrate its effect on stereotypy, this study would seek to detect possible alternative sensory reinforcers that might compete with specific sensory consequences maintaining stereotypy. Functional analyses in Experiment 3 were used to demonstrate the effect of alternative sensory reinforcers.

Finally, if the functions for the student's stereotypy were maintained either by social reinforcement, sensory reinforcement, or multiple reinforcements, this study would test functional analysis findings via a concurrent operants procedure. Experiment 4 sought to examine the effect of functional communication training developed from prior functional analyses to test specific hypotheses regarding the operant functions of stereotypical behavior. According to these purposes, there were several hypotheses in this study:

Hypotheses of the Study

1. The functions of this student's stereotypy may be maintained either by sensory reinforcement, positive social reinforcement, or negative social reinforcement.

2. If the student's stereotypy was maintained by sensory reinforcement, it could be reduced by masking either visual, auditory, or tactile consequences.

3. Alternative sensory reinforcers may be successfully used to compete with the student's stereotypy.

4. Functional communication training developed from the results of function analyses may be successfully taught to reduce the student's stereotypy.

GENERAL METHOD

Student and Setting

Susan was enrolled in a special school which included one teacher and one teacher assistant in her class. She was selected because of her high rates of stereotypical behavior that were exhibited throughout the day. She was 8 years old and classified as severely mentally retarded, physical impaired, and having autistic tendencies. She could feed herself using utensils. She could not walk and often crawled on the floor. She sat in her wheelchair while participating in physical education and in music class. She babbled a lot and sometimes spoke several words or short sentences randomly (e.g., "stop, boy" and " Oh Man"). She also seemed to echo phrases she heard earlier, but with no meaning attached to them. Her auditory comprehensive ability was 6 months and her expres-

sive communication ability 12 months, as measured by the Preschool Language Scale-3; while her communication was 11 months as measured by the Vineland Adaptive Behavior Scales one year ago. Susan could follow simple, verbal commands when accompanied by physical and verbal prompts. Her stereotypy consisted of flexing the fingers of her right hand.

Measures

The independent variables in this study were different manipulative conditions. In Experiment 1, the independent variables were possible operant functions for stereotypy. In Experiment 2, the independent variables were sensory masking conditions employed to reduce stereotypical responses. The main independent variables were an alternative sensory reinforcer and FCT in Experiment 3 and 4, respectively. On the other hand, the dependent variables in this study were stereotypical responses. Susan's stereotypical behavior is finger(s) movement. Her stereotypical responses were defined as "Flip with finger(s)" or "Finger(s) wiggle." The investigator videotaped each condition using a videocassette recorder and a stopwatch. Two observers recorded the frequency of stereotypical responses by employing a 15-s partial interval sampling method. All data were converted to percentage of 15-s intervals during which stereotypical behavior occurred.

Interobserver Agreement

Before conducting the functional analysis, two graduate students in special education were trained for 4 hr to use the observational system and reached a 90% agreement criterion, and then served as observers for all sessions. These two observers recorded data independently and compared with data sheet simultaneously. Across students and experiments an average of 22% sessions (range, 20% to 33%) were scored for interobserver agreement. An agreement was computed using an interval-by-interval agreement method to assess percentage agreement for the frequency of stereotypical behaviors (Kazdin, 1982). Interobserver agreement was computed by dividing the number of agreements by the number of agreements plus the number of disagreements and multiplying by 100%. The interobserver agreement for Susan's stereotypical behavior is 94% (85% to 100%) in Experiment 1, 94% (90% to 100%) in Experiment 2, 95% (90% to 100%) in Experiment 3, and 94% (85% to 100%) in Experiment 4. On the other hand, the interobserver agreement for Susan's sign communication is 96% (85% to 100%).

EXPERIMENT 1: ANALOGUE FUNCTIONAL ANALYSIS

METHOD

Procedure

Before functional analyses were conducted, Susan was observed in her classrooms to analyze possible antecedent and consequence events. She was observed about 6 hr across activities for 1 day.

A multielement design (Sidman, 1960) was employed to assess the occurrence of stereotypy across four conditions: (a) atten-

tion, (b) demand, (c) alone, and (d) play. Each condition was presented once per day for 5 min with a random sequence occurring each day. Sessions were conducted at the same time each day. All sessions were videotaped by a graduate student and recorded by two graduate students using data sheets. The graduate student positioned video camera facing the student from approximately 2 m, repositioning it if the participant moved. These conditions were used to identify possible operant functions that the stereotypy might serve. During the Attention condition, the investigator and Susan were seated next to each other. When seated the investigator read a magazine, while she was provided with toys. If stereotypy occurred, the investigator provided 5 seconds of social comments to her, telling her not to engage in stereotypical responses, and provided physical contact. After the 5 seconds of social comments elapse, the next occurrence of stereotypical responses occasion a similar consequence. All other responses exhibited by the subject were ignored. During the Demand condition, the investigator and Susan were seated next to each other. The investigator delivered a verbal demand every 10 seconds (e.g., "Push the button"). Correct responses were immediately praised and incorrect or no responses resulted in a partial physical prompt after 10 seconds elapsed. Any occurrence of stereotypical responses resulted in 30 seconds cessation of task demands. During the Alone condition, Susan was seated in her wheelchair. No social interaction or activities occurred during this condition. During the Play condition, the investigator and Susan were seated next to each other. Susan was provided with a music toy identified by her teachers as being preferred and was praised every 30 seconds in the absence of stereotypy (occurrences of stereotypical responses were ignored)

RESULTS

Figure 1 displays the results of the functional analysis for Susan. The results for her functional analysis presented a high frequency of stereotypy across all four conditions. For all of the sessions a mean of 89% (range,

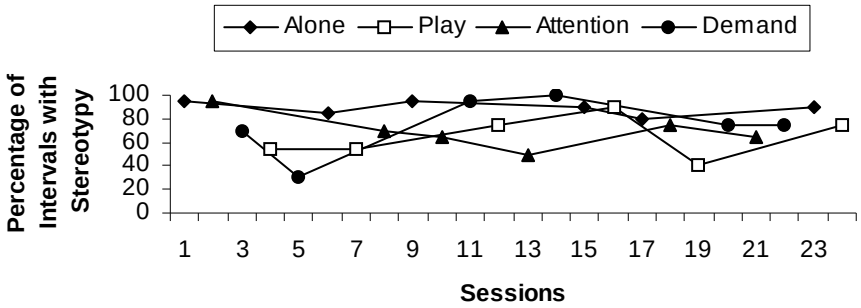

Figure 1. Percentage of intervals engaged in stereotypical behavior in analogue functional analysis

80% to 95%) of intervals contained stereotypy in the Alone condition, a mean of 65% (range, 40% to 90%) of intervals contained stereotypy in the Play condition, a mean of 69% (range, 30% to 100%) of intervals contained stereotypy in the Demand condition, and a mean of 74% (range, 50% to 95%) of intervals contained stereotypy in the Attention condition. The results showed an undifferentiated pattern across all conditions.

EXPERIMENT 2: ANALYSIS OF SENSORY MODALITIES

METHOD

The second study further analyzed high levels of stereotypical behaviors occurring in the Alone condition identified in Experiment 1 to assess possible sensory functions that caused these behaviors. The same definitions of stereotypical responses, measures, settings, and interobserver agreement in Experiment 1 were conducted through this study.

Procedure

Experiment 2 used functional analyses to assess the possible sensory consequences of stereotypy for Susan. A multielement design was used to assess the occurrence of stereotypy across four conditions: (a) Alone, (b) Auditory masking, (c) Tactile masking, and (d) Visual masking conditions. During the Visual masking condition, the investigator and Susan who was seated in a wheelchair, were seated next to each other. One metal plate was put in front of her eyes to cover visual effects possibly produced by stereotypy. The mental plate is 33 cm in length, 30 cm in width, and 1 cm in thickness and was held between eyes and fingers that allowed Susan to exhibit stereotypy, but did not allow her to see her stereotypic responses. During the Auditory masking condition, Susan was seated alone. A pair of plastic safety earplugs was put in her ears to mask possible auditory consequences produced by stereotypy. The earplugs are circular cones with a diameter of 0.6 cm and 1.5 cm in length. During the Tactile masking condition, Susan was seated alone. A pair of gloves was used for her to cover tactile effects possibly produced by stereotypy. During the Alone condition, Susan was seated in a wheelchair and received no social interaction or activities. Each condition was presented once per day for 5 min with a random sequence occurring each day. Sessions were conducted at the same time each day.

RESULTS

Figure 2 displays the results for Susan's analysis of sensory modalities. The results for her analysis of sensory modalities also presented a high frequency of stereotypy across the Alone, Auditory, and Tactile masking conditions, but a low frequency of stereotypy in the Visual masking condition. The results suggest that visual stimulation is functioning as reinforcer for Susan. For all of the sessions a mean of 85% (range, 80% to 100%) of intervals contained stereotypy in the Alone condi-

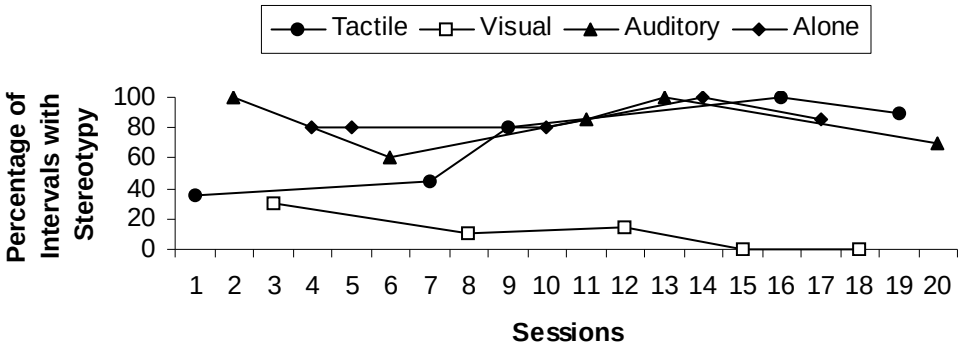

Figure 2. Percentage of intervals engaged in stereotypical behavior in analysis of sensory modalities

tion, a mean of 83% (range, 60% to 100%) of intervals contained stereotypy in the Auditory masking condition, a mean of 70% (range, 35% to 100%) of intervals contained stereotypy in the Tactile masking condition, and a mean of 11% (range, 0% to 30%) of intervals contained stereotypy in the Visual masking condition.

EXPERIMENT 3: ANALYSIS OF COMPETING SENSORY STIMULATION

METHOD

This experiment examined competing sensory stimulation as a means to decrease stereotypy and to further test the sensory consequences identified in Experiment 2.

Procedure

A multielement design was used to assess the occurrence of stereotypy across five conditions: (a) Visual Game, (b) Alone, (c) Tactile masking, (d) Auditory masking and (e) Visual masking conditions. During the Visual Game condition, the investigator and Susan sat next to each other. A preferred hand-held video game was provided to her to compete with possible visual effects created by stereotypy. The Alone, Visual, Auditory, and Tactile masking conditions were the same as those conducted in Experiment 2. Each condition was presented once per day for 5 min with a random sequence occurring each day. Sessions were conducted at the same time each day.

RESULTS

Figure 3 displays the results for Susan's analysis of competing sensory stimulation. Throughout 20 sessions she exhibited a high frequency of stereotypy within the Alone, Auditory, and Tactile masking conditions but a low frequency of stereotypy in the Visual Game and the Visual masking conditions. The results suggest that visual stimulation can be successfully substitutable for her stereo

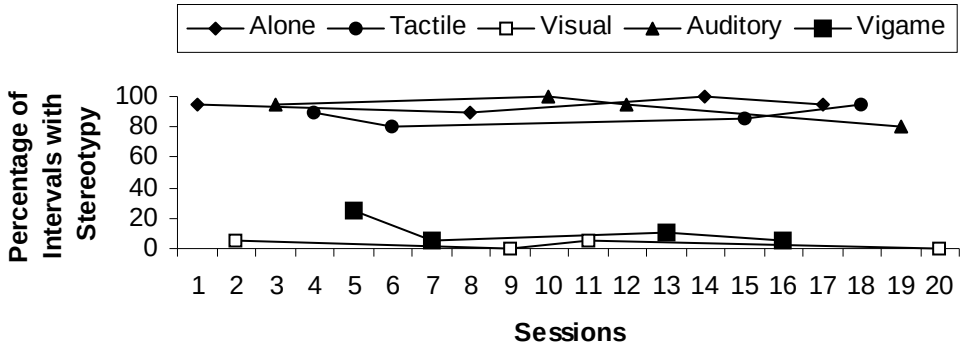

Figure 3. Percentage of intervals engaged in stereotypical behavior in analysis of competing sensory stimulation

typical responses. For all of the sessions a mean of 11% (range, 5% to 25%) of intervals contained stereotypy in the Visual Game condition, a mean of 95% (range, 90% to 100%) of intervals contained stereotypy in the Alone condition, a mean of 93% (range, 80% to 100%) of intervals contained stereotypy in 88% (range, 80% to 95%) of intervals contained stereotypy in the Tactile masking condition, and a mean of 3% (range, 0% to 5%) of intervals contained stereotypy in the Visual masking condition.

EXPERIMENT 4: ANALYSIS OF STEREOTYPY USING A CONCURRENT OPERANTS PROCEDURE

METHOD

Experiment 4 analyzed if stereotypy served distinct and separate operant functions. Because of the undifferentiated results that were obtained in Experiment 1, it was unclear whether stereotypy served multiple operant functions, or only occurred for sensory consequences.

Research Design

A mixed design with an ABAB withdrawal embedded within a multiple baseline design across operant functions was used to evaluate the effects of functional communication training on stereotypical behaviors. The percentage of the time intervals with stereotypy was the dependent variable. Functional communication training developed from Experiments 1, 2, and 3 was the independent variable. All sessions were taken across three conditions including Visual stimulation, Demand, and Attention conditions. Thus, through observation and data collection, the effects of treatment procedure on the stereotypical behaviors were examined.

Procedure

Baseline. Potential operant functions identified in Experiments 1 and 2 were incorporated into the baseline. The three conditions were Visual stimulation, Demand, and

Attention and were used to further test the possibility that multiple functions were served by Susan's stereotypy. During the Visual stimulation condition, Susan was seated in her wheelchair while providing no interaction. The procedures of the Demand and Attention conditions were the same as Experiment 1. The same stereotypical responses and measures as Experiment 1 were conducted.

Functional communicational training. During this phase, a treatment procedure, functional communication training, developed from the result of functional analysis was applied sequentially to stereotypical responses. An alternative behavior was selected to occasion a similar consequence for each response-reinforcer relation established in baseline (Carr & Durand, 1985; Durand & Carr, 1991). Susan was taught alternative responses that would replace her stereotypical responses for visual stimulation, escape, and attention. After the initial baseline was established, intervention began. Susan's stereotypy was maintained by visual consequence, and visual stimulation was effectively substitutable for her stereotypical behavior as demonstrated in Experiments 2 and 3. Therefore, following the baseline and observation, the investigator decided that the first functional communication training would be employed during the Visual stimulation condition. During this condition Susan was seated in her wheelchair, while the investigator sat next to her providing no interaction with her. Following Susan’s fingers movement, the investigator would use functional communication training to physically and verbally prompt her to request to play a videogame by making the sign for videogame (e.g., "Susan, if you want to play the videogame, what do you do?"). After Susan signed for videogame, the investigator would show her the videogame for 15 seconds. Consequences for stereotypical behaviors were the same as stereotypy in the baseline conditions. The physical prompts were faded until Susan's percentage of intervals with sign communication was 20% higher than the average of those in baseline lasting two sessions.

Teaching Susan an appropriate response to remove a difficult task was taught in a similar manner as seeking the videogame play. After Susan exhibited her stereotypical responses during this demand condition, the investigator would physically and verbally prompt her to request a break with the sign for break (e.g., "Susan, if you want a break, what do you do?"). After Susan signed for a break, the investigator would give her a break for 30 seconds. The physical prompts were faded until Susan's percentage of intervals with sign communication was 20% higher than the average of those in baseline lasting two sessions.

Teaching Susan appropriate responses to get the investigator's attention was the last step for intervention. During the Attention condition Susan was seated in her wheelchair, while the investigator sat next to her reading a magazine. Following a stereotypical movement, the investigator would use functional communication training to physically and verbally prompt her to obtain attention

with the sign for attention (e.g., "Susan, if you want my attention, what do you do?"). If Susan signed for attention, the investigator would give her praise and feedback for 5 seconds (e.g., " Susan, I like the way you draw my attention."). The physical prompts were faded until Susan's percentage of intervals with sign communication was 20% higher than the average of those in baseline lasting two sessions.

RESULTS

Figure 4 shows the results for Susan's functional communication training across the Visual game, Demand, and Attention conditions. In the Visual game condition, Susan's

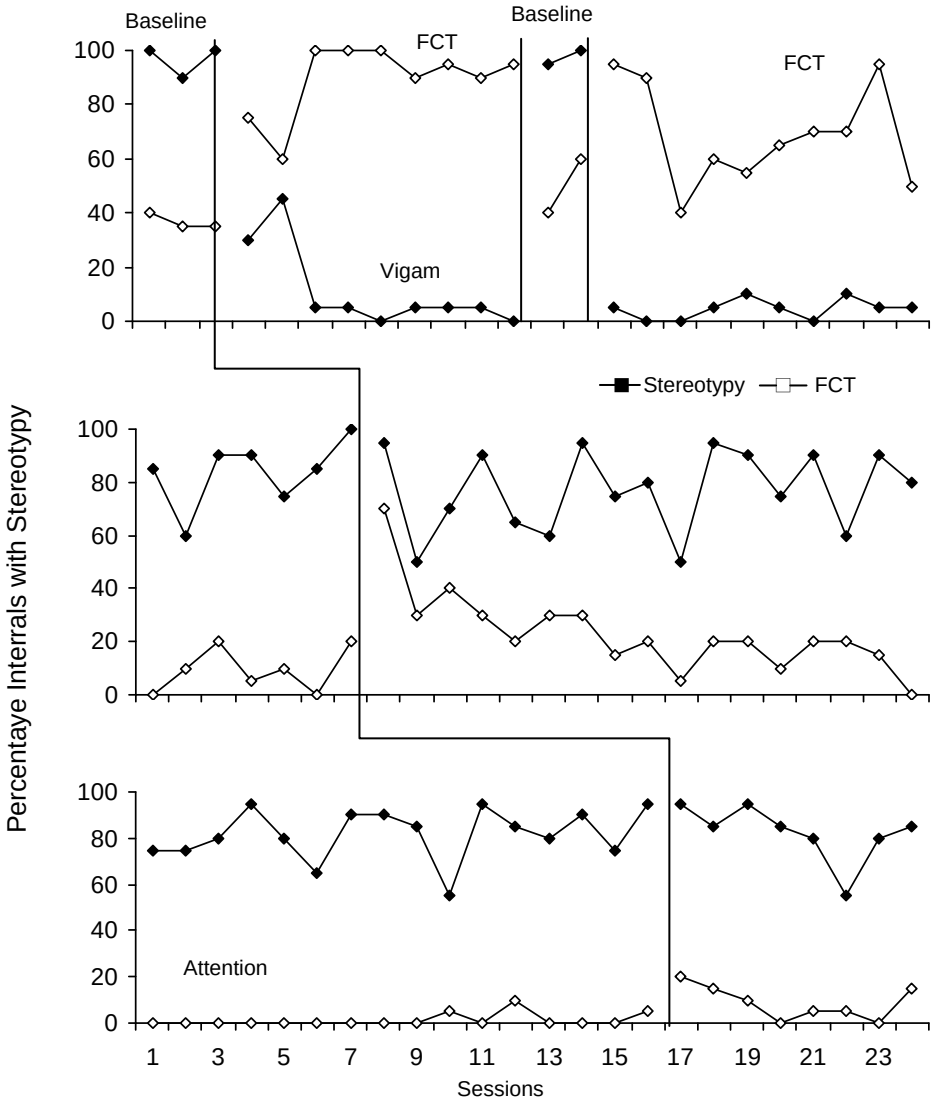

Figure 4. Susan's percentage of intervals engaged in stereotypical behavior in analysis of stereotypy using concurrent

mean percentage of stereotypical responses occurring during the first baseline was 97% (range, 90% to 100%). After 9 sessions of teaching Susan use sign to request videogame, her stereotypical behavior was reduced to a mean percentage of 11% (range, 0% to 45%) in the Visual game condition. However, at this time after 5 second sessions of teaching her use sign to request a break from demand, her rates of stereotypical behavior was still high in the Demand condition (M = 74%; range, 50% to 95%). Therefore, it was reversed to baseline in the Visual game condition. Susan's mean percentage of stereotypical responses occurring during the second baseline was 98% (range, 95% to 100%). After another 10 sessions of teaching Susan use sign to request videogame, her stereotypical behavior was dramatically reduced to a mean percentage of 5% (range, 0% to 10%) in this condition. In contrast, in the Demand condition, her mean percentage of stereotypical responses occurring during the baseline was 84% (range, 60% to 100%). Following the intervention for requesting videogame, the functional communication training for asking a break from a demanding task was introduced to Susan. After 17 sessions of teaching Susan use sign to request a break from task demand, the mean of her stereotypical responses was 77% (range, 50% to 95%). With respect to the Attention condition, her mean percentage of stereotypical responses occurring during the baseline was 82% (range, 55% to 95%). Following the Demand condition, appropriate requesting for attention was taught to Susan. After 8 sessions of teaching Susan use sign to obtain adult's attention, the mean of her stereotypical responses was 83% (range, 55% to 95%).

On the other hand, Susan's communication responses showed an inverse pattern to that for stereotypy only in the Visual game condition. In this condition, Susan's mean percentage of communication responses occurring during the first baseline was 37% (range, 35% to 40%). After 9 sessions of teaching Susan use sign to request videogame, her communication response was increased to a mean percentage of 89% (range, 60% to 100%) in the Visual game condition. When it was reversed to baseline in the Visual game condition, Susan's mean percentage of communication responses occurring during the second baseline was 50% (range, 40% to 60%). After another 10 sessions of teaching Susan use sign to request videogame, her communication response was increased to a mean percentage of 69% (range, 40% to 95%) in this condition. In contrast, in the Demand condition, her mean percentage of communication responses occurring during the baseline was 9% (range, 0% to 20%). After 17 sessions of teaching Susan use sign to request a break from task demand, the mean of her communication responses was 27% (range, 0% to 70%). With respect to the Attention condition, her mean percentage of communication responses occurring during the baseline was only 1% (range, 0% to 10%). After 8 sessions of teaching Susan use sign to obtain adult's attention, the mean of her communication responses was 9% (range, 0% to 20%).

The results from Experiment 4 suggest that although multiple operant functions were attempted to be established, only access to competing visual stimulation (visual game) functioned as a reinforcer and established an alternative response. The results further clarify undifferentiated patterns found in Experiment 1 and suggest that the initial analog functional analysis suggesting an undifferentiated pattern should not be interpreted as identifying multiple functions. Instead, it was revealed that the behavior was only functioning for sensory consequences.

DISCUSSION

Results of the present study demonstrated that sensory reinforcement was a determinant of Susan's stereotypical behavior. The functions of stereotypies were maintained by visual stimulation. In contrast, social reinforcement seemed to have no impact on her stereotypy. This finding suggests that her stereotypical responses occurred frequently in a lack of environmental stimulation without antecedent and consequent events. The implication of this finding emphasizes the importance of interventions designed to provide another appropriate competing sensory reinforcer to replace stereotypy. It is necessary to teach students appropriate way to request the competing sensory stimulation through functional communication training in order to reduce stereotypy.

The present study has shown that individual with developmental disabilities emitted a lot of stereotypical behavior to make sensory input when alone. It supported the hypothesis that stereotypical behavior was maintained by sensory consequences (Lovaas et al., 1987). In consistent with this view, prior studies (Applegate et al., 1999; Mason & Iwata, 1990; Sturmey et al., 1988; Wehmeyer et al., 1993) have demonstrated that high rates of stereotypical behavior occurred in alone conditions. The results of their studies suggest that this behavior functions to obtain sensory reinforcers. However, specific sensory consequences have never been found by these studies. Therefore, specific sensory consequences have to be detected before drawing definite conclusions.

With respect to the analogue functional analysis conducted in Experiment 1, the present data were undifferentiated for Susan, because high levels of stereotypy occurred during all assessment conditions. One possible explanation is that her stereotypy served multiple functions and stimulation provided in the Play (control) condition failed to compete with stereotypy. However, these patterns of stereotypical responses might also suggest that none of the alternative activities available during all assessment conditions could compete with the sensory reinforcers maintaining stereotypical behaviors, and the functions of stereotypy might be merely under control of sensory reinforcement. This possibility is further supported by Experiment 4 which showed Susan's stereotypical responses were merely maintained by sensory reinforcement (visual stimulation). This finding was also supported by Iwata et al. (1994) who showed three subjects exhibited ex-

tremely high levels of self-injurious behaviors during all assessment conditions and suggested that these behaviors were maintained by sensory reinforcement.

Susan's data from the analogue functional analysis indicated that the functions of her stereotypy were undifferentiated across all four conditions, suggesting that her stereotypy might be maintained either by multiple functions or just by sensory stimulation. Through experimental manipulation and analysis of sensory masking of consequences, it was shown that her stereotypical behavior dramatically decreased during the visual masking condition, suggesting that her target behavior served to obtain visual stimulation. Alternative visual stimulation (visual game) was used to compete with her stereotypy in Experiment 3. The results indicated that the alternative visual stimulation almost eliminated her stereotypy. It was further demonstrated that visual stimulation was the source of her stereotypy. Finally, functional communication training was implemented to test the functional analysis findings. The reinforcers used in the functional communication training were equivalent to those maintained by stereotypical behavior. In the visual stimulation condition, functional communication replaced the student's stereotypical behaviors with more appropriate behaviors when provided an equivalent reinforcer to the stereotypical behavior. On the other hand, both in demand and attention conditions, however, functional communication training cannot decrease the student’s stereotypy. These results indicate that stereotypical behavior serves as sensory reinforcement (visual stimulation) rather than multiple functions (positive or negative social reinforcement) and clarify the undifferentiated results found in Experiment 1. However, the pattern in this study seemed inconsistent with those conducted by Kennedy et al. (in press) who showed one subject's stereotypy was maintained by multiple functions including positive and negative social reinforcement, and sensory reinforcement. It could be that there existed different patterns across assessment conditions between these two studies in the analogue functional analysis, and different patterns may reveal different functions of stereotypy. For example, in this study the subject (Susan) exhibited high rates of her stereotypy across all four conditions, whereas the subject in the study of Kennedy et al. (in press) exhibited high rates of his stereotypy across three conditions and low rates only in the Play (control) condition. It is possible that stereotypy across all conditions may be maintained by sensory reinforcement because all alternative stimuli presented could not compete with stereotypy (Iwata et al., 1994). In contrast, stereotypy exhibited all conditions except lower in control (play) condition may be maintained by multiple functions. It could be that stimulus provided in control condition could successfully compete with stereotypy. If this is the case, undifferentiated results in some studies come from analogue functional analysis may be easily interpreted. However, more research needs to be done to confirm this hypothesis.

A related issue is the relation between response function and response topography. The functions of stereotypical behavior may relate to their topographies in analysis of sensory modalities. In this analysis of sensory consequences response topography may imply operant function. That is, the type of stimulation a response produces was associated with the behavior that occurred. It could well be that stereotypical behavior with a specific topography can be predictive of a particular sensory function. For example, Susan was often moving her fingers in front of eyes. Thus, such topography may suggest that visual stimulation functions to maintain her stereotypy. Later on, the visual stimulation was demonstrated to serve as a sensory reinforcer maintaining her stereotypical behavior in Experiments 2, 3, and 4. This finding is consistent with the study of Kennedy and Souza (1995) who showed that self-injurious eye-poking was associated with the visual stimulation it produced. In such cases the topography of the response provides clues as to why the response is occurring. This suggests that the form of a response may predict the sensory function it serves.

The results of this study suggest several areas for further research. More studies extending functional analyses to detect specific sensory consequences maintained stereotypy are needed. Previous studies (e.g., Sturmey et al., 1988) indicated that stereotypy occurred in the Alone condition might be relevant to sensory reinforcement. However, little is known about the actual mechanisms underlying the behavior. The hypotheses regarding what kind of sensory stimulation contributes to stereotypy never be tested thoroughly, so it lacks the evidence that sensory consequence is the cause of stereotypy. At best, these analyses only show some relation between stereotypy and poor environmental stimulation. So far, few studies (e.g., Rincover, 1978) have conducted further analyses to examine what specific sensory consequences might cause stereotypical behaviors. Therefore, there is a need to further extend alone condition analyses which assume a lack of stimulation in the environment to examine specific sensory stimulation that may control stereotypy before more effective environmental stimulation could be adopted.

Furthermore, researchers should pay more attention to analyzing perceptual stereotypy rather than stereotypical object manipulation. One of the earliest studies to assess stereotypy maintained by specific sensory stimulation is Rincover (1978) who masked the sensory consequences postulated to maintain stereotypical behavior and demonstrated spinning plates on table was maintained by auditory stimulation in one student. He masked auditory stimulation for the student and showed decreases in stereotypy. He showed a good path to study specific sensory consequences via masking sensory consequences, however, the student in his study displayed stereotypy of object manipulation rather than perceptual stereotypy. The possibility is high that removal of certain objects might directly eliminate stereotypical responses even though you do not realize the functions of stereotypy. Thus, further studies

need to focus on analyzing perceptive functions of stereotypy instead of object manipulative stereotypy.

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多重障礙孩童固著行為的功能分析與介入

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目前學界對固著行爲（stereotypical behavior）的起因與功能仍不清楚。有些行爲分析學家們從操作制約觀點研究，發現該行爲的功能可能是感官增強、社會性正增強、社會性負增強、或多重性增強所引起的。本研究共有四個子研究，對一位多重障礙學童的固著行爲進行功能分析，並以功能溝通的訓練方式對個案介入。研究一、以類似的功能分析（analogue functional analysis）從操弄四種情境（引起注意、工作要求、單獨、及遊玩情境）來分析該學童固著行爲的功能。結果顯示：四種情境都無法對固著行爲產生區分性的結果。研究二、以功能分析來操弄四種情境（單獨、聽覺遮蔽、觸覺遮蔽、及視覺遮蔽情境）來分析造成固著行爲的感官功能。結果顯示：只有在視覺遮蔽的情境下，固著行爲顯著減少。研究三、繼續以功能分析來操弄五種情境（視覺刺激的遊戲、單獨、聽覺遮蔽、觸覺遮蔽、及視覺遮蔽情境）來檢視視覺刺激的遊戲能否與固著行爲產生對抗的效果。研究顯示：視覺性的遊戲能成功地替代固著行爲。研究四、以混合式的實驗設計（倒返實驗設計結合多基準線設計）來評量功能溝通訓練對固著行爲所產生的影響。研究結果顯示：在視覺刺激的情境下，功能溝通訓練能有效地減少固著行爲。最後，本研究對固著行爲的感官功能、多重功能、以及形態（topography）與功能的關係進一步地討論，並對未來的研究提出建議。

關鍵字：多重障礙、固著行爲、功能分析