Functional Analysis of Oral-digital Stereotypy in a Student with Profound Mental Retardation

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Abstract: *The current study included two experiments that functionally analyzed stereotypical oral-digital behavior of one female student with profound mental retardation. An analogue functional analysis was used in Experiment 1 to detect the function of the student's oral-digital 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 maintaining the student's repetitive oral-digital. Results of the present study demonstrated that multiple consequences which included drawing attention from teachers and producing sensory stimulation could serve to maintain this student's stereotypy. The specific sensory function of this student's oral-digital stereotypy might be maintained by tactile stimulation. These findings were further discussed in terms of the sensory and social reinforcers that execute their impacts on this student's stereotypical behavior, and procedures used to detect those functions.*

INTRODUCTION

People with profound mental retardation, autism, or related severe disabilities often exhibited high levels of stereotypical behaviors. Such behaviors are usually defined as rhythmic, repetitive, and nonfunctional body movements, that usually occur in the form of oral-digital contact, finger sucking, body rocking, mouthing, head-nodding/shaking, tapping objects, repetitive vocalizations, spinning objects, and complex hand or finger movement (Foxx & Azrin, 1973; Koegel & Covert, 1972; LaGrow & Repp, 1984). This aberrant behavior could affect learning activities if exhibited

at high rates (Koegel & Covert, 1972; Singh, Landrum, Ellis, & Donatelli, 1993). Therefore, detecting the functions of stereotypy and reducing this disruptive 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 (Berkson & Mason, 1963; Chock & Glahn, 1983). However, functional relationships between such variables and stereotypy were never examined, and interventions were employed directly in these studies, such that little is known regarding the functions of these variables. On the other hand, despite a variety of behavioral techniques being used to decrease stereotypy of people with severe disabilities in studies (LaGrow & Repp, 1984), little attention has been paid to the functions of these behaviors. Researchers have often been concerned about the effectiveness of techniques but have never explained why they used such techniques in studies. Without finding the functions of stereotypy, researchers cannot develop appropriate treatment strategies. Therefore, the effects of interventions for persons with stereotypies have always been inconsistent (Lovaas, Newsom, & Hickman, 1987). Further exploration to examine the functions that might exert their control over stereotypy is needed.

It was initially assumed that stereotypical behavior was maintained by sensory consequences (Lovaas et al., 1987; Sprague, Holland, & Thomas, 1997). If stereotypy occurs with and without task demands, across most settings (Rincover, Cook, 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 (Devany & Rincover, 1982; Rincover et al., 1979). In accordance with these findings, Mason and Newsom (1990) investigated 3 children with severe mental retardation and also found that sensory changes effectively reduced children's repetitive hand movements. These studies suggest that sensory consequences function as positive and/or negative reinforcers maintaining stereotypy.

Recent studies used analogue functional analyses (Iwata et al., 1994) to simulate a lack of environmental stimulation. If environments occasion people to engage 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 (Sturmey, Carlsen, Crisp, & Newton, 1988; Wehmeyer, Bourland, & Ingram, 1993). They pointed out that high levels of stereotypy associated with alone conditions would suggest that aberrant behavior was maintained through intrinsic reinforcement (homeostatic or self-stimulation), if such environments provide impoverished and austere levels of stimulation. Consistent with this view, in an earlier study that examined the effects of toys on stereotypy, Berkson and Mason (1964) found that 12 persons with mental retardation exhibited higher rates of stereotypic responding in the empty (alone) condition than the observer (person present) condition. The same results were reported by Runco, Charlop, & Schreibman (1986), showing that the highest rates of stereotypic behavior occurred when the children were left alone in a separate room.

More evidence comes from studies using analogue functional analyses to detect the relationship between alone settings and stereotypical behaviors (Applegate, Matson, & Cherry, 1999; Mason & Iwata, 1990; Sturmey et al., 1988; Wehmeyer et al., 1993).

These studies suggest a lack of stimulating environments can control high rates of stereotypic behaviors. On the other hand, stereotypy might also be emitted to reduce over stimulation (i.e., negative sensory reinforcement).

Some researchers also found that noisy situations may serve as a negative reinforcer to control stereotypy. For example, using analogue functional analyses to assess the causes of stereotypy in one student with autism, Tang, Kennedy, Koppekin, and Caruso (2002) have shown that stereotypical behaviors (covering ears with hands) served to escape from noises in the environment. Covering ears served as an escape from peers' screaming or crying. This study suggests that stereotypy might function as negative sensory reinforcement to escape or avoid high arousal and/or noises in the environment.

Although sensory consequences may contribute to the maintenance of stereotypic responses, there is a lack of 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. In most cases, it is often hard to detect sensory consequences. In some cases there have been no antecedent consequence events associated with stereotypy. Therefore, unless all potential antecedent and consequence variables that might contribute to stereotypy are thoroughly examined, there remains a lack of evidence to show that sensory consequences cause stereotypy.

Purpose of the Study

The first purpose of this study was to examine possible functions of one student's oral-digital 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 an escape from task demand, obtaining attention from the investigator, 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.

Hypotheses of the Study

1. The functions of this student's oral-digital stereotypy may be maintained either by sensory reinforcement, positive social reinforcement, or negative social reinforcement.
2. If the student's oral-digital stereotypy was maintained by sensory reinforcement, it could be reduced by masking either visual, auditory, or tactile consequences.

GENERAL METHOD

Students and Settings

Mary was enrolled in a special school which included one teacher and one teacher assistant in each class. She was selected because of her high levels of oral-digital behavior that were exhibited throughout the day. She was a 9-year-old girl classified as having profound mental retardation. She could not walk or eat without assistance from others. She was unable to speak as well. In contrast, her auditory comprehensive ability was fine due to her ability to understand some simple directions given by her parents or teachers. Additionally, she often sucked her fingers while sitting on a chair in the classroom.

Measures

The dependent variables were stereotypical oral-digital responses. Her stereotypical response was defined as "Touching her lips with

fingers or one thumb. Or putting her fingers into her mouth." 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 5 hours to use the observational system. They recorded 90% agreement criterion, and served as observers for all sessions. These two observers recorded data independently and simultaneously. Then they compared each other's data sheet. Across experiments an average of 25% of sessions (range, 20% to 32%) was 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 Mary's stereotypical behavior was 88% (range, 80% to 100%) in Experiment 1, and 94% (range, 85% to 100%) in Experiment 2, respectively.

EXPERIMENT 1: ANALOGUE FUNCTIONAL ANALYSIS

Method

Before functional analysis was conducted, Mary was observed in her classrooms to analyze possible antecedent and consequence events. She was observed three hours across activities for one day.

A multielement design (Sidman, 1960) was employed to assess the occurrence of stereotypy across four conditions: (a) social, (b) demand, (c) alone, and (d) play. Each condition was presented once per day for 5 minutes 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 the video camera facing the student from approximately two meters, repositioning it if the participant moved. These conditions were used to identify possible operant functions that the stereotypy might serve. During the Social condition, the investigator sat beside Mary. When seated, the investigator read a magazine, while the subject was provided with toys. If stereotypy occurred, the investigator provided five seconds of social comments to her, telling her not to engage in stereotypical responses, and provided physical contact. After the five seconds of social comments elapse, the next occurrence of oral-digital occasions a similar consequence. All other responses exhibited by Mary were ignored. During the Demand condition, the investigator sat beside Mary. The investigator delivered a verbal demand every ten seconds (e.g., "Put the blocks in the cup"). Correct responses were immediately praised and incorrect or no responses resulted in a partial physical prompt after ten seconds elapsed. Any occurrence of stereotypical oral-digital resulted in thirty seconds cessation of task demands. During the Alone condition, Mary was seated on a chair. No social interaction or activities occurred during this condition. During the Play condition, the investigator sat beside Mary. Mary was provided with various toys identified by the teachers as being preferred and was praised every thirty seconds in the absence of oral-digital (occurrences of stereotypical responses were ignored).

Results

Figure 1 displays the results of the functional analysis for Mary's stereotypical oral-digital. Throughout 24 sessions Mary exhibited a high frequency of stereotypy either within the Alone conditions or within the Social conditions. For all of the sessions a mean of 23% (range, 10% to 30%) of intervals contained oral-digital stereotypy in the Alone condition, a mean of 1% (range, 0% to 5%) of intervals contained stereotypy in the Play condition, a mean of 4% (range, 0% to 15%) of intervals contained stereotypy in the

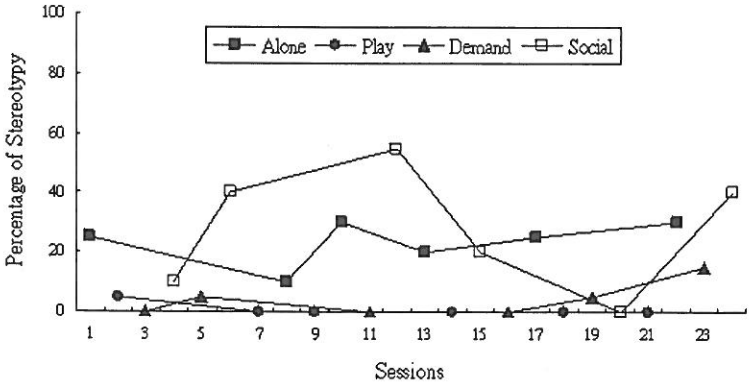

Figure 1

Mary's percentage of intervals engaged in oral-digital stereotypy in analogue functional analysis

Demand condition, and a mean of 28% (range, 0% to 55%) of intervals contained stereotypy in the Social condition. The results suggest that functions of her oral-digital may be relevant to social reinforcement and sensory reinforcement. Because Mary's high levels of oral-digital response occurred only in the Alone and Social conditions, it could be that she exhibited lots of stereotypy to obtain self sensory content during Alone condition in which no social interaction or activities occurred, and to draw attention repetitively from other persons during Social condition in which the investigator provided social comments to stop her oral-digital responses. The probability is high that such stereotypic oral-digital responses may be maintained by multiple sources including sensory consequences and social attention from others.

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 specific sensory functions that caused these behaviors. The same definitions of stereotypical responses, measures, settings, and interobserver agreement in Experiment 1 were used.

Procedure

Experiment 2 used functional analyses to assess the possible sensory consequences of stereotypy for this student. 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. If the lowest levels of stereotypy occurred in the auditory masking condition, this would suggest that Mary's stereotypy could be maintained by auditory stimulation. In contrast, if the lowest levels of stereotypy occurred in the visual masking condition, this would suggest that Mary's stereotypy could be maintained by visual stimulation. Besides, the alone condition without any masking was used as a control condition. During the Visual masking condition, the investigator and the target student were seated next to each other. One pair of plastic safety goggles was used to mask the visual effects for Mary. The goggles surrounded her eyes approximately 2 cm away from the top, bottom, and sides of her eyes, with the front shield approximately 2 cm from her face. The goggles were held in place by an elastic band that wrapped around the back of Mary's head and attached at the sides of the goggles. During the Auditory masking condition, Mary was seated alone on the chair. A pair of plastic safety earplugs was put in her ears to mask possible auditory consequences produced by stereotypy. The earplugs were circular cones with a diameter of 0.6 cm and 1.5 cm in length. During the Tactile masking condition, a pair of gloves was used for her to cover tactile effects possibly produced by her stereotypy. During the Alone condition, Mary sat on a chair and received no social interaction or activities. Each condition was presented once per day for five minutes with a random sequence occurring each day. Sessions were conducted at the same time each day.

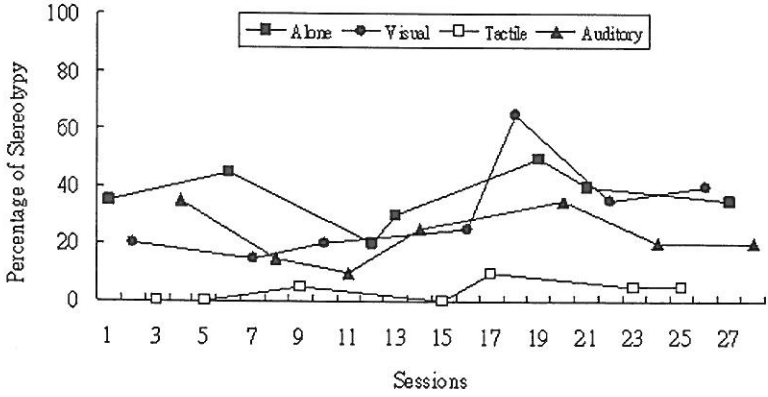

Figure 2

Mary's percentage of intervals engaged in oral-digital stereotypy in analysis of sensory modalities

Results

Figure 2 displays the results for Mary's analysis of sensory modalities. Throughout 28 sessions Mary exhibited a high frequency of stereotypy within the Alone, Auditory, and Visual masking conditions, but a lower frequency of stereotypy in the Tactile masking condition. For all of the sessions a mean of 36% (range, 20% to 50%) of intervals contained oral-digital stereotypy in the Alone condition, a mean of 23% (range, 10% to 35%) of intervals contained stereotypy in the Auditory masking condition, a mean of 31% (range, 15% to 65%) of intervals contained stereotypy in the Visual masking condition, and a mean of 4% (range, 5% to 10%) of intervals contained stereotypy in the Tactile masking condition. The results suggest that tactile stimulation functions as a reinforcer for Mary's repetitive stereotypy. Through repetitive touch between her fingers and mouth, Mary might gain sensory consequences, especially tactile stimulation by herself. During tactile masking condition, a pair of gloves was used for her to mask tactile effects produced by putting her fingers into mouth, and the rates of her oral-digital stereotypy decreased dramatically. It could be that she no longer obtained tactile stimulation through

oral-digital response during tactile masking conditions. Therefore, oral or/and digital stimulation may function as a reinforcer for Mary's stereotypical responses.

DISCUSSION

Results of the present study demonstrate that multiple consequences might serve to maintain Mary's stereotypy. Sensory self-stimulation and attention from others (social reinforcers) could be a determinant of stereotypical oral-digital behavior in Mary, as Mary exhibited high levels of stereotypical behavior during the Social condition in which the investigator repetitively asked her to stop stereotypical response after it occurred. It might be that people in naturalistic environments non-intentionally provided positive reinforcement for her (gave her attention) to engage in stereotypical behavior by making comments every time her stereotypic behavior occurred. Therefore, she may frequently use oral-digital behavior to draw other people's attention in natural environments. In contrast, she also displayed many oral-digital responses during the Alone condition in which she was never provided any interaction. It is possible that she repetitively exhibited such oral-digital stereotypy in naturalistic settings to produce sensory self stimulation due to a lack of environmental stimulation without any antecedent and consequent events (Iwata et al., 1994). This study also supported the hypothesis that stereotypical behavior was maintained by sensory consequences (Lovaas et al., 1987). Prior studies (Applegate et al., 1999; Mason & Iwata, 1990; Mason & Newsom, 1990; Sturmey et al., 1988) 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.

On the other hand, Mary's stereotypy seemed to be maintained by positive social reinforcement at times, suggesting that it occurred frequently in drawing others' attention as well. It is consistent with the study conducted by Frea and Hughes (1997).

They used functional analyses to assess two adolescent students with mental retardation who exhibited inappropriate social-communicative behaviors, and found that one student's high rates of speech stereotypy was maintained by social attention. Dadds, Schwartz, Adams and Rose (1988) also provided data supporting this stance. A study by Dadds et al. (1988) revealed that twelve autistic children's high rates of stereotypy were associated with social attention settings. Therefore, it is still uncertain which consequence mainly dominated the stereotypy exhibited by Mary. Further studies need to be conducted to test these multiple perspectives.

Another interesting issue raised by the current findings is the source of self-stimulation of Mary's oral-digital. The present study revealed that Mary's sucking fingers could be maintained by tactile consequences. The results show that masking Mary's fingers with a pair of gloves reduced her stereotypical behavior (putting her fingers into her mouth). The source of self-stimulation for Mary may be her fingers as suggested by the reduction of her oral-digital stereotypy after masking, as showed in Experiment 2. The results are consistent with the study conducted by Goh et al. (1995) who found that subjects' hand mouthing (including putting fingers into mouth) was maintained by sensory reinforcement and was primarily maintained by hand stimulation. However, it should be noted that the effects of tactile masking seemed moderate (see Figure 2; tactile masking cannot completely eliminate Mary's stereotypic responses). Thus, the result should be taken with caution. It is not clear whether her mouth was the source of self-stimulation due to the difficulty of masking her mouth or both sources (mouth and fingers). If the latter hypothesis is the case, blocking either source may reduce her stereotypical behavior. Therefore, more research is needed in this area.

The results of this study suggest several areas for further research. First, more studies extending functional analyses to detect specific sensory consequences maintaining stereotypy are needed. Previous studies (Runco et al., 1986; Sturmey et al., 1988) indicated that stereotypy that 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 has never been tested thoroughly, so there is a lack of evidence that sensory conseqüence is the cause of stereotypy. At best, these analyses only show some relation between stereotypy and poor environmental stimulation. So far, few studies (Patel, Carr, Kim, Robles, Eastridge, 2000; Rincover, 1978) have conducted further analyses to examine what specific sensory consequences might cause stereotypical behaviors. Therefore, before more effective environmental stimulation could be adopted, 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.

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