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ANALYSIS OF SELF-RECORDING IN SELF-MANAGEMENT INTERVENTIONS FOR STEREOTYPY

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Most treatments for stereotypy involve arrangements of antecedent or consequent events that are imposed entirely by a therapist. By contrast, results of some studies suggest that self-recording, a common component of self-management interventions, might be an effective and efficient way to reduce stereotypy. Because the procedure typically has included instructions to refrain from stereotypy, self-recording of the absence of stereotypy, and differential reinforcement of accurate recording, it is unclear which element or combination of elements produces reductions in stereotypy. We conducted a component analysis of a self-management intervention and observed that decreases in stereotypy might be attributable to instructional control or to differential reinforcement, but that self-recording per se had little effect on stereotypy.

Key words: stereotypy, functional analysis, self-management, self-recording, instructions, differential reinforcement

Stereotypy consists of a large collection of chronic, repetitive behaviors that are considered maladaptive and disruptive to learning. Stereotypy commonly is observed in individuals with intellectual disabilities and also is one of the main diagnostic criteria for autism (American Psychiatric Association, 2000). Although many topographies of stereotypy have been observed (body rocking, hand flapping, bizarre vocalizations, etc.), the common feature of all these behaviors is that they seem to persist independent of social consequences.

A number of interventions have been shown to be effective in decreasing stereotypy (see Rapp & Vollmer, 2005, for a review). Many studies have examined reinforcement-based procedures, such as noncontingent access to items that compete with stereotypy (NCR; Horner, 1980), differential reinforcement of alternative behavior (DRA; Mulick, Hoyt, Rojahn, &

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Schroeder, 1978), or differential reinforcement of other behavior (DRO; Repp, Dietz, & Speir, 1974; Ringdahl et al., 2002). Other studies have examined interventions that attenuate the reinforcement available for stereotypy, such as increasing the amount of effort required to engage in stereotypy (Irvin, Thompson, Turner, & Williams, 1998) or decreasing the sensory input produced by stereotypy (Rincover, Cook, Peoples, & Packard, 1979). When these interventions are ineffective, punishment-based strategies, such as overcorrection (Foxx & Azrin, 1973) or response blocking (Lindberg, Iwata, & Kahng, 1999), represent alternative strategies. It is important to note that all of these interventions involve antecedent or consequent events imposed entirely by a therapist.

By contrast, a small body of research has examined one component of self-management interventions, namely, self-recording, as a therapeutic intervention for stereotypy. Although the mechanisms by which self-management interventions produce behavior change have been the subject of some disagreement (Nelson & Hayes, 1981), the intervention has been shown to be effective in increasing, as well as decreasing, the frequency of a wide range of target behaviors exhibited by individuals with intellectual disabilities (Harchik, Sherman, & Sheldon, 1992).

R. L. Koegel and Koegel (1990) reported the use of a self-management intervention to decrease stereotypy exhibited by four children and adolescents with autism. All subjects engaged in multiple topographies of stereotypy, and, although a functional analysis was not conducted, the authors noted that these behaviors "did not appear to serve any function other than to provide sensory input" (p. 120). During baseline, consequences for stereotypy were similar to those delivered by subjects' parents and teachers, which typically included reprimands or redirection to other tasks. Following baseline, subjects were taught to record whether a therapist modeled occurrences or nonoccurrences of stereotypy. After the discrimination was acquired, a self-management intervention was implemented, during which the therapist delivered instructions to refrain from engaging in stereotypy and delivered reinforcers when subjects accurately recorded the absence of stereotypy. Results showed that the intervention decreased all subjects' stereotypy, even though subjects only recorded the absence of stereotypy accurately (mean accuracy, 93%). By contrast, accuracy of "recording" the occurrence of stereotypy (not marking in the box following intervals in which the subject engaged in stereotypy) averaged only 39%.

Shabani, Wilder, and Flood (2001) replicated the R. L. Koegel and Koegel (1990) procedures with an individual who engaged in body rocking and found that the intervention was effective in reducing body rocking to zero across two settings. In addition, zero levels of body rocking were maintained after the reinforcement schedule was thinned from an initial interval of 10 s to 17 to 20 min.

Although subjects' self-recording of their behavior played a prominent role in the R. L. Koegel and Koegel (1990) and Shabani et al. (2001) studies, the direct influence of self-recording on stereotypy is difficult to determine because instructions to refrain from stereotypy were delivered, and reinforcers were delivered only for accurately recording the absence of stereotypy. Thus, it is possible that other variables, such as instructional control or the DRO contingency alone, in addition to or instead of self-recording, might have produced reductions in the subjects' stereotypy. The purpose of this study was to conduct a component analysis of the self-management intervention described by R. L. Koegel and Koegel and by Shabani et al. to identify the variables that are responsible for producing reductions in stereotypy exhibited by individuals with autism.

METHOD

Subjects, Target Behaviors, and Setting

Three individuals who attended a day program for adults with intellectual disabilities

(Aaron and Earl) or a special education school (Curtis) participated. All subjects had been diagnosed with autism and engaged in stereotypy frequently throughout the day. In addition, all subjects communicated vocally, followed multiple-step instructions, were able to read, and had no physical impairments that interfered with their ability to perform the self-recording response. Subjects were included in the study if results of a functional analysis indicated that their stereotypy was maintained by automatic (sensory) reinforcement, and this was true for the first three subjects identified for inclusion. Aaron was a 40-year-old man who engaged in head weaving (repeated head movement in a side-to-side motion) that interfered with his ability to attend to tasks and disrupted social interactions. Earl and Curtis engaged in bizarre vocalizations. Earl was a 49-year-old man whose vocalizations consisted of loud noises, repetitive mumbling, and speech not directed to another person. Curtis was a 12-year-old boy whose vocalizations consisted of high-pitched squealing or other vocalizations not directed to another person and unrelated to any ongoing events. Earl's and Curtis's bizarre vocalizations were disruptive to others and interfered with their ability to engage in appropriate social interactions. Sessions were conducted in a room away from others at the day program or the school.

Response Measurement and Reliability

The study was conducted in two phases that consisted of a functional analysis of stereotypy followed by a component analysis of the self-management intervention. Trained observers used handheld computers to collect data on the percentage of 10-s intervals in which stereotypy occurred. Reliability was assessed for at least 20% (range, 20% to 78%) of sessions during each condition of the functional analyses and component analyses for all subjects. Agreement percentages for interval data were calculated by dividing the number of intervals in which both observers scored the occurrence or nonoccurrence of the behavior by the total number of intervals in the session and multiplying by 100%. Interobserver agreement for all subjects' stereotypy averaged 95% (range, 48% to 100%); scores below 70% were obtained in two sessions only.

Observers also collected data on subjects' accurate or inaccurate self-recording of their behavior (as well as on Aaron's accurate copying of words) during the component analysis of the self-management intervention. Reliability was calculated for frequency data by dividing session time into continuous 10-s intervals and comparing observers' records on an interval-by-interval basis. The smaller number of responses in each interval was divided by the larger; these fractions then were summed across the session and multiplied by 100%. Interobserver agreement for all subjects' accurate self-recording, as well as for Aaron's word copying, averaged 96% (range, 77% to 100%) in these phases. Interobserver agreement for all subjects' inaccurate self-recording (and word copying) averaged 99% (range, 86% to 100%).

PHASE 1: FUNCTIONAL ANALYSIS

Functional analyses of each subject's stereotypy were conducted in a multielement design using methods similar to those described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994). Sessions lasted 10 min and were conducted in an observation room (Aaron and Earl) or a classroom (Curtis) that contained relevant session materials. Each subject was exposed to three test conditions (alone or ignore, attention, and demand) and a control condition (play). The alone (or ignore) condition was alternated with all other conditions in a 2:1 ratio to allow more frequent observation of subjects' stereotypy in the absence of programmed social consequences.

During the alone condition (Aaron and Earl), the subject was alone in a room without access

to any leisure or edible items. During the ignore condition (Curtis), the subject was seated in a secluded area of a classroom without access to any leisure or edible items, and no consequences were delivered for stereotypy. Other individuals in the room were engaged in varied activities and were instructed to avoid eye contact and interaction with Curtis in any manner during sessions. During the attention condition, the subject was seated or standing in a room with the therapist and had access to moderately preferred leisure items. At the start of session, the therapist informed the subject that she had "work to do" and that they could talk later. The therapist then engaged in other tasks and ignored the subject, except to deliver a brief reprimand (e.g., "Stop making that noise.") contingent on the occurrence of stereotypy. During the demand condition, the subject was seated at a table next to the therapist. The therapist presented academic or vocational tasks using a three-step prompting sequence (vocal, model, and physical prompts) throughout the session and delivered praise as a consequence for compliance. Contingent on the occurrence of stereotypy, the therapist removed the task materials and turned away from the subject for 30 s. During the play condition, the subject was seated or standing in the room with the therapist and had free access to at least two highly preferred leisure items. The therapist interacted with the subject at least once every 30 s and whenever the subject initiated interaction. No consequences were delivered following stereotypy.

Three patterns of responding were considered indicative of maintenance by automatic reinforcement: (a) higher levels of stereotypy during the alone (or ignore) condition compared to all other conditions, (b) undifferentiated levels of stereotypy across all conditions with maintenance of stereotypy in the alone or ignore condition, or (c) high levels of stereotypy in all conditions except the play condition.

PHASE 2: COMPONENT ANALYSIS OF THE SELF-MANAGEMENT INTERVENTION

The purposes of this phase were to replicate systematically the self-management intervention described by R. L. Koegel and Koegel (1990) and Shabani et al. (2001) and to determine which components of the procedure were responsible for observed reductions in stereotypy. All sessions lasted 10 min, and a reversal design was used to evaluate the relative effects of the procedures on subjects' stereotypy.

Prior to the start of the component analysis, a paired-stimulus preference assessment (Fisher et al., 1992) was conducted with all subjects to identify a highly preferred edible item (one selected on 80% or more trials) to be used as a reinforcer during training and intervention sessions. Based on the assessment, Cheetos were selected for Aaron, Fritos were selected for Earl, and Slim Jims were selected for Curtis.

All subjects were exposed to the following conditions: (a) baseline, (b) self-recording training, and (c) differential reinforcement of accurate self-recording (DR [accurate]). Based on the subject's performance during these conditions, additional conditions were conducted to provide a component analysis of the self-recording intervention. The rationale and procedural details for these conditions are provided in the results section.

Baseline

The subject and a therapist were seated next to each other at a table, and no other materials were present. The therapist did not interact with the subject at any time and did not deliver any consequences following occurrences of stereotypy. In other words, these sessions were similar to the ignore condition of the functional analysis.

Training the Self-Recording Response

Following baseline and prior to the start of the DR (accurate) phase, the subject was taught

to discriminate between occurrences and nonoccurrences of his stereotypy. Before each training session, the therapist described the training procedure to the subject using a script similar to the following:

> [Subject's name], watch what [model's name] does. Sometimes [model's name] will be head weaving [i.e., the target stereotypic behavior, which the model demonstrated at this time], and you will need to mark the "head weaving" box [the therapist pointed to the stereotypy box on the self-recording sheet]. And sometimes [model's name] will be sitting still [i.e., not engaging in stereotypy, model demonstrated sitting still and quiet], and you will need to mark the "sit still" box [the therapist pointed to the no-stereotypy box on the self-recording sheet.] If you record correctly, you will get a [highly preferred edible item].

During training sessions, the model performed the subject's particular topography of stereotypy during five occurrence trials and sat quiet and still during five nonoccurrence trials. Trials lasted 10 s, and trial types (occurrence and nonoccurrence) were presented in random order. Before each trial, a timer was set for 10 s. When the timer sounded, the therapist prompted the subject to record the model's behavior as an occurrence or nonoccurrence of stereotypy (e.g., "Did she head weave or sit still? Make a mark."). The subject indicated whether stereotypy was or was not modeled by placing a mark in the corresponding box on a self-recording sheet.

Each self-recording sheet contained two boxes, one under the heading "Head Weaving" (Aaron) or "Inappropriate Talk" (Earl and Curtis) to correspond to the occurrence of stereotypy, and the other under the heading "Sit Still" (Aaron) or "Quiet" (Earl and Curtis) to correspond to the absence of stereotypy. Each box type was affixed to a different brightly colored paper to aid the subjects in discriminating between the two types of boxes.

Following an accurate recording of the occurrence or nonoccurrence of stereotypy, the therapist delivered praise plus the edible item. If the subject recorded inaccurately (marked that stereotypy occurred when it had not been modeled or vice versa), the therapist delivered feedback (e.g., "No, she was sitting still.") and physically guided the subject to place a mark in the correct box. If the subject did not place a mark in either box following the model, the therapist delivered a second verbal prompt to record (e.g., "Did she head weave or sit still? Write it down."). If the subject recorded accurately following either prompt, the therapist delivered praise plus an edible item. If the subject again did not record or recorded inaccurately, the therapist provided feedback and physically guided the subject to place a mark in the correct box on the self-recording sheet but did not deliver praise or the edible item.

Training continued until the subject accurately recorded the model type after the first or second verbal prompt on 90% or more of the trials or until the total training session time equaled 1 hr, whichever came first. If the subject did not acquire the recording response after 1 hr of training, additional training components were added until the subject was able to record the model type accurately. These additional components included (a) shortening the model duration from 10 s to 5 s, (b) implementing overcorrection following incorrect responses, in which the subject was guided physically to record correctly three times following an incorrect recording, (c) interspersing one model of the occurrence of stereotypy within nine models of the nonoccurrence of stereotypy and vice versa, and (d) showing 10-s video clips of the subject either engaging in stereotypy or engaging in other appropriate behaviors.

Differential Reinforcement (Accurate)

Although subjects had recorded a model either engaging or not engaging in stereotypy during training, they had not recorded their own behavior. Thus, DR (accurate) was designed to teach subjects to record occurrences and nonoccurrence of their own stereotypy accurately. During these sessions, the therapist

and subject were seated at a table in the session room. A timer, self-recording sheets, writing utensils, and the edible reinforcers were placed on the table. The self-recording sheets were identical to the sheets used during training.

At the start of each session, the therapist set the timer for 30 s and instructed the subject to record his behavior accurately to receive reinforcement when the timer sounded. When the timer sounded, the subject was asked to place a mark in the appropriate box on the self-recording sheet to indicate whether or not he had engaged in stereotypy at any time during the interval. If the subject placed a mark in the correct box (in the occurrence box if the subject engaged in stereotypy or in the nonoccurrence box if the subject had not engaged in stereotypy), the therapist delivered praise (e.g., ''Good job recording.'') plus one edible item. The therapist did not comment on whether the subject had engaged in stereotypy during DR (accurate) sessions. Accurate self-recording of the occurrence or nonoccurrence of stereotypy resulted in reinforcer delivery in this condition to evaluate directly the effects of self-recording per se on levels of stereotypy.

If the subject did not record the occurrence or nonoccurrence of stereotypy within 3 s of the timer sounding, the therapist delivered a verbal prompt for the subject to record his behavior (i.e., ''You need to record correctly.''). If the subject placed a mark in the correct box, the therapist delivered praise plus the edible item. If the subject did not comply within 3 s or recorded incorrectly, the therapist physically guided the subject to place a mark in the appropriate box but did not deliver praise or an edible item. Prompts were delivered following no response to increase the probability that each subject would acquire and perform the self-recording response during this condition. Once recording was completed, regardless of accuracy, the timer was reset for 30 s.

Prompt fading. After a subject independently recorded his stereotypy with 80% or greater accuracy for two consecutive sessions, the therapist increased the latency from the timer sounding to the delivery of the verbal prompt by 2 s. This prompt delay was increased by 2 s following each session with 80% or greater accurate and independent self-recording until prompts no longer were required.

Schedule thinning. If low levels of stereotypy were observed, the self-recording interval was increased by 50% of its previous value. In other words, depending on the subject's level of stereotypy in this or subsequent conditions, the reinforcement schedule was thinned as follows: 30 s, 45 s, 70 s, and so on.

RESULTS

Figure 1 shows results of the subjects' functional analyses. Aaron (top) engaged in higher levels of stereotypy in the alone condition than in all other conditions. Earl (middle) engaged in variable levels of stereotypy in all conditions. Curtis (bottom) engaged in variable levels of stereotypy in all test conditions and relatively low levels in the play condition; however, he continued to engage in variable levels of stereotypy during consecutive ignore sessions. These patterns of responding, although somewhat different, indicated that subjects' stereotypy was not differentially sensitive to social contingencies and most likely was maintained by automatic reinforcement.

Figure 2 shows results obtained during treatment conditions. Because each subject experienced a different set of conditions to provide a component analysis of the self-recording intervention following the DR (accurate) condition, procedural descriptions and results are presented separately for each subject.

Aaron

Aaron engaged in variable levels of head weaving during the initial baseline condition. Prior to the start of the DR (accurate) condition, he achieved 100% accuracy in recording the occurrence and nonoccurrence of stereotypy in one training session. His

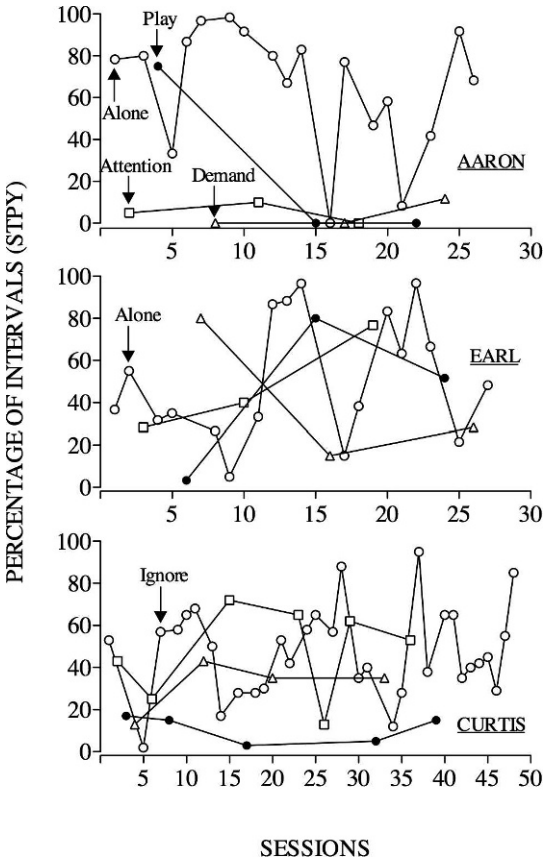

Figure 1. Functional analysis results for Aaron's head weaving, Earl's bizarre vocalizations, and Curtis's bizarre vocalizations.

stereotypy subsequently decreased immediately to zero during the DR (accurate) condition, when reinforcers were delivered for accurate self-recording regardless of stereotypy. A return to baseline resulted in an increase in stereotypy. Because the DR (accurate) condition contained implicit instructions to refrain from stereotypy (the words "Sit Still" were written on the self-recording sheet) plus the self-recording activity, we delivered instructions to refrain from stereotypy but substituted an irrelevant activity (copying an unrelated word on an index card) during the next condition (control activity). The purpose of this condition was to determine whether instructional control and the availability of an alternative activity, rather than self-recording, might have been responsible for observed reductions in Aaron's stereotypy in the preceding condition.

Prior to the start of each control-activity session, the therapist instructed Aaron to sit still and explained that reinforcers would be earned if he correctly copied one word from a stack of index cards onto a piece of paper with the words "Sit Still" printed across the top. Aaron then was given writing utensils, and the timer was set. When the timer sounded, the therapist delivered praise and an edible item if Aaron accurately copied a word from an index card onto the paper. None of the words in the stack of index cards pertained to stereotypy or the self-recording intervention, and no consequences were delivered contingent on stereotypy in this condition. In other words, reinforcers were delivered for accurately copying the irrelevant word regardless of whether Aaron engaged in stereotypy during the interval.

During the control-activity condition, Aaron's stereotypy decreased immediately to near-zero levels. Similar effects were observed in the final baseline and control-activity sequence: Aaron engaged in high levels of stereotypy during baseline, engaged in near-zero levels of stereotypy, and copied words with 100% accuracy at the end of every interval during the final control-activity condition.

Earl

Earl engaged in high, stable levels of stereotypy during baseline. Prior to the DR (accurate) condition, he learned to perform the self-recording response with 90% accuracy in three sessions. His stereotypy decreased during the first session of the DR (accurate) condition but then returned to baseline levels. It is interesting to note that he accurately recorded occurrences of stereotypy during this condition.

DRO plus self-recording was implemented next and closely replicated the original procedures used by R. L. Koegel and Koegel (1990) and Shabani et al. (2001). The purpose of this condition was to determine whether a contingency for accurately self-recording the absence

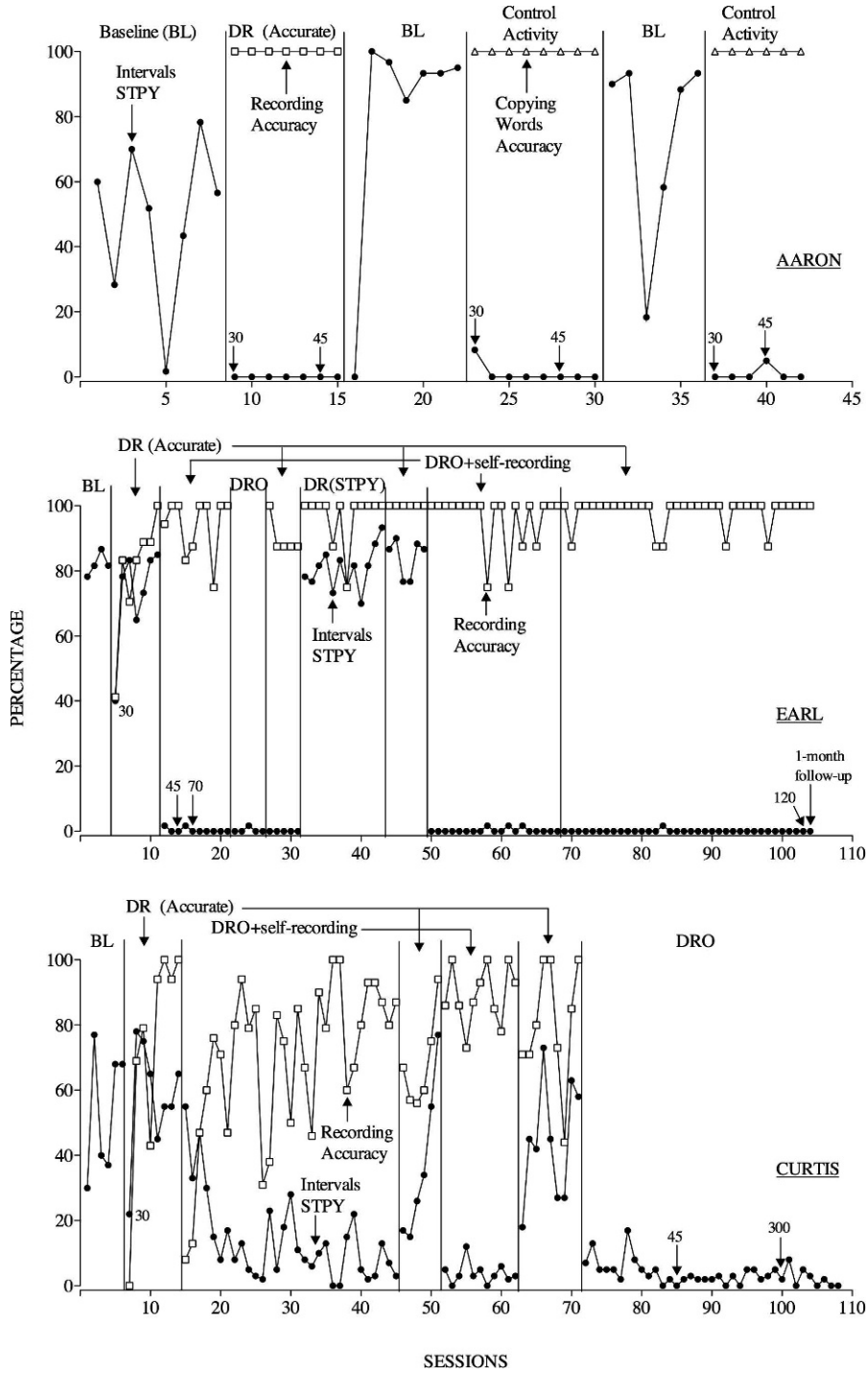

Figure 2. Results of the component analysis of the self-management intervention on Aaron's, Earl's, and Curtis's stereotypy (STPY). Filled circles represent stereotypy, open squares represent accurate self-recording, and open triangles (Aaron only) represent accurate copying of irrelevant words. Numbers near data points denote the interval value (in seconds) for self-recording (all subjects), DRO (Earl and Curtis), or copying a word (Aaron only). Unless otherwise noted, subsequent conditions began with the last interval value of the preceding condition. DR = differential reinforcement.

of stereotypy would be effective in reducing it. Prior to the start of each session, the therapist told Earl that reinforcers could be earned by refraining from engaging in stereotypy and accurately recording the absence of stereotypy. Earl had access to writing utensils and self-recording sheets that contained only one box. This sheet was identical to the side of the DR (accurate) sheets for the nonoccurrence of stereotypy (the box was labeled ''Quiet'' and was affixed to the same brightly colored paper as in the DR [accurate] condition). When the session began, the therapist set the timer for 30 s. Each time the tone sounded, the therapist delivered praise (e.g., ''Good job being quiet.'') plus one edible item if Earl had not engaged in stereotypy and had marked the self-recording sheet. If he engaged in stereotypy at any time during the interval and did not mark the self-recording sheet, the therapist delivered praise (e.g., ''That's right; you were making noise.'') but not an edible item. Finally, if Earl engaged in stereotypy at any time during the interval but marked the self-recording sheet, the therapist delivered verbal feedback (e.g., ''No, you were making noise.'') and did not deliver an edible item. During this condition, the self-recording interval was thinned from 30 s to 70 s.

Introduction of DRO plus self-recording (reinforcement only for accurately recording the absence of stereotypy) resulted in reductions in Earl's stereotypy to near-zero levels. It was unclear, however, whether self-recording was necessary to maintain low levels of stereotypy; therefore, the self-recording component was removed during the subsequent DRO-only condition.

Prior to the start of each DRO session, the therapist told Earl that reinforcers could be earned only for the absence of stereotypy. When the session began, the therapist set the timer for 70 s (the last value of the recording interval in previous conditions). Each time the tone sounded, the therapist delivered praise plus one edible item if he had not engaged in stereotypy at any time during the interval. If he had engaged in stereotypy, the therapist delivered feedback (''No, you made this noise: [modeled stereotypy].'') and did not deliver an edible item at the end of the interval.

Low levels of stereotypy were maintained when the self-recording component was removed in the DRO-only condition and remained low when the DR (accurate) condition, which previously had been ineffective, was reinstated. Thus, Earl's data suggested that DRO per se was effective in decreasing stereotypy but that exposure to either DRO plus self-recording or to DRO alone might have accounted for the absence of stereotypy when the DR (accurate) condition was reinstated. To determine whether his recent reinforcement history influenced responding during the DR (accurate) condition, a different history was established by reinforcing accurate recording of occurrences of stereotypy during a DR (stereotypy) condition.

Prior to the start of each DR (stereotypy) session, the therapist told Earl that reinforcers could be earned by engaging in stereotypy and accurately recording its occurrence. He had access to writing utensils and self-recording sheets that contained only one box. This sheet was identical to the side of the DR (accurate) sheets for the occurrence of stereotypy (the box was labeled ''Inappropriate Talk'' and was affixed to the same brightly colored paper as in the DR [accurate] condition). When the session began, the therapist set the timer for 70 s. Each time the tone sounded, the therapist delivered praise plus an edible item if Earl engaged in stereotypy and marked the self-recording sheet. If he did not engage in stereotypy and did not mark the self-recording sheet, the therapist delivered praise but not an edible item. Finally, if Earl did not engage in stereotypy and marked the self-recording sheet, the therapist delivered feedback (e.g., ''No, you were quiet.'') and did not deliver an edible item.

During the DR (stereotypy) condition, Earl accurately recorded the occurrence of stereotypy, and his stereotypy increased to near-baseline levels. The DR (accurate) condition then was reinstated, and his behavior was similar to that observed during the initial DR (accurate) condition. In other words, he accurately recorded occurrences of stereotypy and engaged in it frequently. Earl's final conditions, DRO plus self-recording followed by DR (accurate), replicated the sequence to which he was exposed initially, and similar results were obtained. To determine if this apparent historical influence might have lasting effects, a follow-up session was conducted 1 month after the termination of data collection and resulted in both accurate recording and the complete absence of stereotypy.

Curtis

Curtis engaged in variable levels of stereotypy during baseline. Prior to the DR (accurate) condition, numerous sessions and several variations of the training procedures were required before he learned to perform the self-recording response consistently with 90% accuracy. Ultimately, he learned to self-record by watching 10-s video clips of himself engaging or not engaging in stereotypy; however, 52 training sessions had been conducted before he met the mastery criterion. Implementation of the DR (accurate) condition had no effect on his stereotypy, although he learned to record its occurrence accurately.

Next, DRO plus self-recording was implemented (procedures were similar to those used for Earl). Stereotypy gradually decreased during this condition but subsequently increased to baseline levels when the DR (accurate) condition was reinstated. These results were different than those observed for Earl, and, despite the extended duration of his DRO plus self-recording condition, it was possible that additional exposure to DRO plus self-recording might result in therapeutic maintenance during a subsequent DR (accurate) phase. Therefore, we repeated the DRO plus self-recording condition and observed reductions in stereotypy, but these reductions again failed to be maintained when DR (accurate) was reinstated. Given these results, Curtis's final condition consisted of DRO only, without the self-recording component, which resulted in low levels of stereotypy that were maintained even as the DRO interval was thinned from 30 s to 5 min.

DISCUSSION

Results of previous studies (R. L. Koegel & Koegel, 1990; Shabani et al., 2001) indicated that a self-management intervention that consisted of instructions, self-recording, and reinforcement for the absence of stereotypy effectively decreased the frequency of stereotypy; however, the influence of self-recording per se was not examined. Results of this study indicated that self-recording was unnecessary for (Aaron) or ineffective in (Earl and Curtis) reducing any of the subjects' stereotypy. More specifically, reductions in stereotypy were produced by instructional control and access to an alternative activity (Aaron), a recent history of reinforcement for accurately recording the absence of stereotypy (Earl), or the DRO reinforcement contingency itself (Curtis).

Aaron's data indicated that self-recording was not responsible for reductions in his head weaving. In fact, simply instructing Aaron to refrain from stereotypy and providing an alternative activity at least every 30 to 45 s was sufficient to reduce his stereotypy to zero immediately. This effect was established during the control-activity condition in which near-zero levels of stereotypy were observed when instructions were delivered to refrain from stereotypy and reinforcers were delivered for copying an irrelevant word at the end of the interval. Although the relative influence of instructional control and access to the control activity in suppressing stereotypy cannot be determined from the data, features of the self-recording materials (i.e., the words ''Sit Still''

written over one box) might have functioned as an instruction to refrain from stereotypy throughout the interval. In addition, results of his functional analysis suggested that simply providing access to any alternative activity might be effective in reducing Aaron's stereotypy, because he engaged in stereotypy most often during the alone condition when no materials were present.

Similarly, self-recording per se was not effective in reducing Earl's stereotypy, in that he continued to engage in high levels of bizarre vocalizations during the initial DR (accurate) condition when reinforcers were delivered for accurate self-recording (whether or not stereotypy occurred). It was only following a history with the DRO contingency that reinforcement for accurate self-recording was effective in maintaining low levels of stereotypy, as was demonstrated in subsequent exposures to the DR (accurate) condition. Most relevant was the DR (stereotypy) followed by DR (accurate) sequence in which, following a history of reinforcement for accurately recording the occurrence of stereotypy, he continued to do so when the occurrence of stereotypy no longer mattered. These results suggest that, for some individuals, a particular history of reinforcement for the absence of problem behavior might be necessary before self-recording interventions can be used to maintain low levels of behavior. Newman, Tuntigian, Ryan, and Reinecke (1997) evaluated procedures similar to those used in the DRO plus self-recording followed by DR (accurate) sequence of Earl's component analysis and showed that a "self-reinforcement" intervention following a history of DRO maintained reductions in the problem behaviors of three individuals with autism. The experimenters delivered tokens contingent on the absence of problem behavior in the first intervention phase. In the second phase, subjects were prompted to take a token following an interval in which they did not engage in problem behavior. In the last phase, subjects were permitted to take tokens independently at the end of the interval. In light of Earl's results, it is possible that, without the preceding history of DRO, the self-reinforcement intervention used in the Newman et al. study might not have been sufficient to produce reductions in the subjects' problem behaviors.

Finally, Curtis's results showed that DRO was necessary to produce reductions in his bizarre vocalizations, in that accurate self-recording in the DR (accurate) phases never resulted in low levels of stereotypy. Furthermore, DRO alone (without self-recording) was effective in maintaining low levels of stereotypy, even during interval durations up to 5 min.

Results of this study also suggest that self-recording interventions designed to reduce problem behaviors can be difficult to implement. First, teaching the self-recording response might require a significant time investment. Curtis, for example, required over 5 hr of training before an effective procedure was identified to bring the self-recording response under discriminative control of his own behavior. Difficulties in teaching individuals with autism to self-record their behavior accurately also have been reported in other studies. For example, Mancina, Tankersley, Kamps, Kravits, and Parrett (2000) reported that it took approximately 18 hr of instruction before a young girl with autism was able to perform the self-recording response (as part of a self-management intervention) to decrease her inappropriate vocalizations. Conversely, this training might be justified for some individuals as a maintenance procedure following a history of DRO, as suggested by Earl's results. The prerequisite skills or subject characteristics necessary to produce these effects are not clear, however, because some studies have shown that self-management can be effective as a maintenance procedure for some individuals (Newman et al., 1997) but not for others (Santogrossi, O'Leary, Romanczyk, & Kaufman, 1973). Future research might attempt to identify the

prerequisite skills or subject characteristics that are predictive of successful self-management interventions for problem behavior exhibited by individuals with autism.

Sustained reductions in problem behaviors also might require continuous monitoring of the client's behavior such that reinforcers can be delivered (a) contingent on a target response (e.g., accurate self-recording), as was the case for Earl in the DR (accurate) condition; or (b) for the absence of problem behavior, as was the case for Curtis during the final DRO intervention. This finding is not unique to the present study; Mancina et al. (2000) also reported that their subject never learned to perform the self-management intervention independently, in spite of continued prompting and reinforcement throughout the study. Even when self-recording can be acquired and can be shown to produce reductions in problem behavior, frequent monitoring of the subject's behavior is still needed (Gross & Wojnilower, 1984). For example, Freeman and Dexter-Mazza (2004) evaluated a self-recording intervention to decrease the off-task and disruptive behavior of one typically developing adolescent. They found that self-recording was not sufficient to reduce problem behavior unless a classroom aide continuously monitored the subject's behavior and delivered reinforcers contingent on 80% or better accuracy in self-recording. If frequent monitoring of the individual's behavior is necessary to produce and maintain reductions in problem behaviors, clinicians may wish to consider simpler strategies for reducing problem behaviors, such as establishing stimulus (or instructional) control over appropriate behavior, using standard DRO procedures to decrease problem behaviors, or teaching more adaptive replacement behaviors (appropriate leisure skills) via DRA.

It remains unknown, however, whether self-recording has any advantages over DRO alone in terms of efficiency of initial behavior suppression, maintenance during reinforcement schedule thinning, or generalization across settings. Previous research has produced mixed results regarding the effectiveness of DRO as a sole intervention for behavior maintained by automatic reinforcement (e.g., Piazza, Fisher, Hanley, Hilker, & Derby, 1996; Shore, Iwata, DeLeon, Kahng, & Smith, 1997); however, DRO alone was effective in reducing stereotypy in this study, even at lengthy DRO intervals (300 s). It is possible that discriminative properties of the self-recording materials might promote these effects, because research already has demonstrated that stimulus control over stereotypy can be established using punishment procedures (Doughty, Anderson, Doughty, Williams, & Saunders, 2007; Rapp, Patel, Ghezzi, O'Flaherty, & Titterington, 2009; Woods, 1983). Alternatively, statement of the reinforcement contingency (instructions) might have contributed to the effectiveness of DRO in this study. For example, Ringdahl et al. (2002) showed that an intervention that consisted of DRO plus a statement of the reinforcement contingency was effective in reducing the stereotypic hand flapping of an individual with mild mental retardation and a seizure disorder and that reductions were maintained as the DRO interval was thinned to 600 s. Future research might examine the potential stimulus control aspects of self-recording plus DRO, which might make it more advantageous as an intervention for stereotypy than DRO alone.

Finally, we must emphasize the fact that our findings and conclusions are limited to situations in which self-recording is used to decrease problem behavior. Self-recording has been used to strengthen or maintain a variety of adaptive responses exhibited by individuals with intellectual disabilities (see Harchik et al., 1992, for a review), including work productivity (Christian & Poling, 1997), social skills (L. K. Koegel, Koegel, Hurley, & Frea, 1992), and appropriate toy play (Stahmer & Schreibman, 1992). For example, Stahmer and Schreibman taught three children with autism to play appropriately with

various toys using prompting, DRA, and a self-management intervention. Self-management materials were faded gradually from the training setting, and the subjects were observed in other settings to determine whether appropriate toy play would be maintained and collateral reductions in stereotypy would be observed. They found that the intervention was effective in increasing appropriate play and decreasing stereotypy, and that these effects were maintained in the training and generalization settings after the self-management materials were faded gradually. Thus, it is possible that adaptive behaviors continue to occur when self-recording interventions are withdrawn, presumably because these behaviors contact naturally occurring reinforcement contingencies. Similar effects might not be obtained when the focus of treatment is response suppression, however, if self-recording does not compete effectively with reinforcement that maintains problem behavior.

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