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ORIGINAL PAPER

Social Interaction and Repetitive Motor Behaviors

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Abstract Students with autism have difficulty initiating social interactions and may exhibit repetitive motor behavior (e.g., body rocking, hand flapping). Increasing social interaction by teaching new skills may lead to reductions in problem behavior, such as motor stereotypies. Additionally, self-monitoring strategies can increase the maintenance of skills. A multiple baseline design was used to examine whether multi-component social skills intervention (including peer training, social initiation instruction, and self-monitoring) led to a decrease in repetitive motor behavior. Social initiations for all participants increased when taught to initiate, and social interactions continued when self-monitoring was introduced. Additionally, participants' repetitive motor behavior was reduced. Changes in social behavior and in repetitive motor behavior maintained more than one month after the intervention ended.

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Social dysfunction, a primary feature of autism, may be its most defining characteristic (Rogers 2000). Individuals with autism, regardless of their level of intellectual functioning, display social deficits (Frea 1995) that persist throughout life (Freeman 1997). Improving social functioning is one of the most daunting and important challenges to professionals working with children with autism (Rogers 2000; Weiss and Harris 2001).

In particular, a lack of verbal and non-verbal social initiations is common, even among individuals with autism who are relatively responsive to other's initiations (Mundy and Stella 2000). When children fail to make initiations, they miss the learning opportunities that normally follow initiations such as "Look!" and "What's that?" Limited to only the information others choose to provide to them, children with autism often lack the learning opportunities and independence that accompany the ability to seek out information from the environment (Koegel et al. 1999).

Repetitive motor behavior (e.g., body rocking, hand flapping, finger tapping, etc.) also causes myriad difficulties for individuals with autism. Because of its odd and, for some individuals, noisy nature, repetitive motor behavior can create social stigma for students with autism and may further reduce opportunities for interaction with peers (Durand and Carr 1987), can prevent some students from being included in general education settings, and may interfere with students' ability to attend to and engage in academic instruction (Koegel and Covert 1972) and toy play (Koegel et al. 1974; Nuzzolo-Gomez et al. 2002). Accurate performance of learned tasks may also suffer

when a child with autism engages in motor stereotypies (Morrison and Rosales-Ruiz 1997).

Behavior interventions are often successful in reducing stereotypic behaviors, such as repetitive motor movements (e.g., Foxx and Azrin 1973; Hanley et al. 2000; Haring and Kennedy 1990; Ringdahl et al. 2002), although the process of individually targeting each undesired behavior is quite time-consuming (Lovaas 1977). Repetitive motor behaviors may be maintained by environmental factors or may be automatically reinforcing. In the case of the latter, providing a child with competing items or activities that are incompatible with stereotypy can result in behavioral reduction. To this end, a number of studies suggest that engaging the child in an incompatible behavior or in social interaction leads to a decrease in repetitive motor behavior. For example, repetitive motor behaviors appear to occur less often when children interact with family members and with adults (Brusca et al. 1989; Donnellan et al. 1984). Teaching a skill such as functional communication (Bird et al. 1989; Durand and Carr 1991; Wacker et al. 1990) and book or toy play (Nuzzolo-Gomez et al. 2002) may also be helpful in reducing repetitive behaviors.

Self-monitoring interventions, in which the individual is taught to discriminate and to make a record of the occurrence or non-occurrence of a target behavior (Kamps and Tankersley 1996), appear to be helpful at increasing desired behaviors, while collaterally reducing undesired behaviors. Further, self-monitoring interventions may increase the likelihood that the positive effects of an intervention will maintain in the long term because the control of the intervention is transferred from the adult to the child.

Self-monitoring increases independence and encourages self-control, which are important qualities that are often overlooked in other intervention approaches. In order to self-monitor, an individual must pay adequate attention to his or her own behavior, the conditions under which these behaviors occur, and the immediate and distal effects that are produced. When individuals self-monitor, they attend to select aspects of behavior on which they may ordinarily not focus.

Self-monitoring interventions have been used with children with autism to reduce stereotypic behavior (Koegel and Koegel 1990), increase appropriate play (Stahmer and Schreibman 1992), increase use of daily living skills in the absence of the treatment provider (Pierce and Schreibman 1994), and increase on task behavior (Koegel et al. 1999; Callahan and Rademacher 1999). These behavior changes were accompanied by collateral reductions in self-stimulatory and stereotypic behavior (Stahmer and Schreibman 1992; Pierce and Schreibman 1994) and disruptive behavior (Koegel et al. 1999).

Few studies have examined the use of self-management techniques to increase and maintain social interaction in students with autism. Morrison et al. (2001) taught students with autism requesting, commenting, and sharing. Students with autism and their typically developing peers were also taught to monitor the behaviors. The intervention resulted in a greater frequency of social interactions between group members and an increase in social initiations by the students with autism. Self-monitoring interventions were also demonstrated to increase varied responding in play and in social language (Newman et al. 2000) and to increase social responsivity in multiple community settings, while collaterally decreasing disruptive behavior (Koegel et al. 1992). When working with children with autism and their siblings, Strain and Kohler (1994) found that a self-monitoring intervention, coupled with adult prompts and reinforcement, increased the social interactions of children with autism with their siblings and non-disabled peers. In a combined video modeling and self-monitoring package, Apple et al. (2005) found that the compliment-giving behaviors of children with autism increased and that the self-monitoring component of the intervention was both effective and efficient.

Investigations of the relationship between peer interaction and repetitive motor behavior are less common, but a small body of literature suggests that as social engagement increases repetitive behaviors will decrease. In an investigation of a cognitive–behavioral intervention designed to enhance the social-communicative functioning of children with autism, Bauminger (2002) found an increase in a variety of pro-social behaviors. Additionally, participants were less likely initiate repetitive ritualistic behaviors following the intervention. Lord and Hopkins (1986) investigated the social interaction of children with autism in integrated same-aged and cross-aged dyads. They found that children with autism displayed fewer stereotypic behaviors when interaction increased in cross-aged dyads. Finally, in two peer-mediation intervention studies, Lee and Odom (1996) and Lee et al. (2007) found that when the peers without disabilities initiated social interaction and the children with disabilities increased their social engagement, collateral decreases in stereotypic behaviors occurred.

The current study examined the effects of an intervention package to increase the social initiations and corresponding social interactions of children with autism and their typically developing peers. The intervention package included peer training and explicit instruction in how to initiate social interactions, as well as a self-monitoring component to promote maintenance of new skills after the teaching phase ended. The collateral relationship between engagement in social interaction and repetitive motor behavior was also examined. Specifically, the

following research questions were addressed: (a) Does an intervention package including peer training, direct social initiation training, and self-monitoring lead to increased social initiations and ensuing interactions? (b) Does the intervention package lead to a collateral decrease in repetitive motor behavior?

Method

Participants

Three students with autism participated in this study. Participants were first identified with autism by school system personnel. When tested by his school psychologist, each participant was reported to have cognitive functioning scores in the average or above range and each was included in the general education setting. The first author administered the Autism Diagnostic Observation Schedule (ADOS; Lord et al. 2001) and DSM-IV criteria for Autistic Disorder to confirm the existing autism diagnosis. The scores for all three participants fell in the Autism range on the ADOS and met DSM-IV criteria.

"Stuart" was a 9-year-old, third grader. During the administration of the ADOS and in pre-baseline school observations, Stuart engaged in a variety of repetitive motor behaviors (detailed below). Rarely, Stuart would interact with one peer for brief periods during lunchtime. More often, he repetitively flipped pages in a dinosaur book or engaged in repetitive motor behaviors when he was not eating. "Anthony" was a 10-year-old, 4th grade boy. In the ADOS administration session and in school observations, Anthony engaged in a variety of repetitive motor behaviors (detailed below). Anthony was rather isolated from the other boys at his table in the cafeteria. He appeared completely absorbed in eating and in his repetitive behaviors and did not interact, even though he sat quite near other students. "William" was a 10-year-old fifth grader. During school observations and the ADOS administration, William exhibited many repetitive motor behaviors (detailed below). Other students at his table in the cafeteria watched William and sometimes laughed at his behavior. However, he only rarely interacted with other boys. When he did speak to them, it was often to simply repeat a line of dialogue from a popular cartoon.

Typical peers were recruited after the participants with autism were identified. The investigator met with each child's teacher and asked which peers the child with autism preferred. Among those, boys reported to be enthusiastic to help peers and eager to work with adults were selected. The peers who participated were each in the same class as the corresponding child with autism. None of the peers and participants met outside of school before the intervention began.

Setting

The intervention took place in an elementary school in rural Indiana during the third, fourth, and fifth graders' lunch and recess periods. Data were collected during lunch. Each lunch period lasted approximately 30 min and was followed by a 20-min recess.

Materials

A golfer's wrist counter was used for the self-monitoring component of the intervention. Reinforcers, specific to the interests of each target child and his peer, were selected based on information provided in interviews with parents and teachers. Items included pencils, toy cars, plastic dinosaurs, and colorful capsules that turned into dinosaur shapes when submerged in water.

Observation and Measurement

A 5-min sample of social initiation, social interaction, and stereotypy data were collected daily for each participant. A partial interval-based recording system was used and data were collected in 10-s intervals, followed by 10 s to record behavior. This resulted in 15 intervals for each day of data collection. The operational definitions were created for each dependent variable. The 5-min sample was collected when each participant had finished eating. This period was a highly social time when students remained in their seats and waited to be released for recess.

Social Initiation

Social initiation with peers was defined as the participant starting an interaction with a peer(s) with whom there has not been an interaction during the previous 5 s.

Social Interaction

Social interaction was defined as any verbal or gestural behavior directed toward the child with autism or the peer within 5 s after an initiation or an ensuing response.

Repetitive Motor Behaviors

Due to the idiosyncratic nature of repetitive behaviors, a specific, complete definition was determined for each child on an individual basis using information obtained from

observation. To be counted, motor movements of the same topography that occurred two or more times within 5 s were counted.

Repetitive motor behaviors for Stuart took several forms and included: clapping that was unrelated to environmental events (i.e., not following a performance); rubbing palms of hands together; hand movements (touching thumb to index finger, tapping hands with fingertips, rubbing hands together); pumping arms as if running; tapping others when unrelated to social initiation or response; full body rocking from front to back or side to side; twisting body on cafeteria seat; audible self-talk (not directed at another child or adult); and squinting, winking, or other exaggerated eye movements.

Anthony engaged in the most visible, intense repetitive motor behavior. This included: hand movements (clapping or making a clapping motion without contact, rubbing palms together, finger movements in front of face, hand flapping); feet motions (shaking feet, sliding out of shoes and moving feet back-and-forth on lunch table); full body rocking; head movements (shaking and nodding unrelated to social interaction, holding head at an odd angle while watching another body part or object); arm movements (twisting arms together in yoga-like pose, shaking arms) spinning objects or parts of objects; and rubbing arms or legs.

William engaged in more subtle, slower motor movements. Including: putting non-edible items into his mouth (empty condiment packets, books, clothing, etc.); licking lunch tray, chip bag, or other non-edible items; fine hand movements, such as touching index finger to thumb repeatedly; whole body rocking; eating extremely small bites, such as one kernel of corn or one piece of shredded carrot in an exaggerated manner; eyebrows up and down, unrelated to socially directed facial expression; and face oriented towards lights or ceiling.

Interobserver Agreement

Before the study began, a primary (an undergraduate research assistant) and reliability observer (the first author) trained to use the observation system and reached 85% ($k = .80$) agreement criterion on all categories. The data collection training took place during the students' lunch after consent was obtained and the students were still being assessed. Together the primary and reliability observers observed and recorded behavior for a 5-min interval. They met daily until the criterion was reached for each behavior and for each participant.

Because behaviors were individually defined for each participant, interobserver agreement on occurrence was calculated separately for each dependent variable, for each student using *kappa* (Cohen 1965). For behaviors that occurred very rarely or not at all (such as social initiations during baseline and repetitive motor behavior during intervention), only percent agreement was calculated. Once the reliability observer met the criteria, both of the primary and reliability observers simultaneously and independently recorded behaviors of the same child during 25% of total sessions. Ongoing agreement checks occurred during the baseline, intervention, and maintenance phases.

Social Validity

A pre and post-treatment survey addressing each of these areas was administered to parents and teachers (available from the first author upon request), including questions about the goals, procedures, and outcomes of the study. Further, anecdotal social validity information (e.g., conversations, e-mail correspondence) was collected informally from peers, parents, and teachers when the first author was contacted by parents and school staff to discuss the intervention. Finally, information obtained from students' individualized education plans (IEP's) was used to ensure that the objectives of the intervention fit with each participant's IEP goals.

Procedure

Before data collection began, the investigator met with the participants' parents, obtained informed consent, observed the participants in several settings, and developed the operational definitions of the dependent variables. Then, the investigator and research assistant met together to establish interobserver reliability.

Baseline

During the baseline condition, the participants and their peers were greeted by the investigator or research assistant, but no further interaction occurred between the children and the adult. They proceeded with lunch as usual. Data were collected for a 5-min sample for each participant. Probes were also collected during recess.

Peer Training

A natural positive consequence for social initiations is a positive response from a peer. To ensure that children with autism received such natural consequences, peers were taught to positively respond. In one 5–10 min individual

training session, the researcher taught the peers to naturally reinforce social initiations from the child with autism (participate in conversation or in play when the child with autism initiates) and to make certain they have the child's attention before responding, by making eye contact or moving an object into the child's line of vision (adapted from Pierce and Schreibman 1994).

Social Initiation Instruction

The first author taught participants with autism to socially initiate to ensure that they had the requisite initiation skill prior to learning the self-monitoring strategy. The intervention included three primary components: task analyses in natural settings; sequential teaching of the task-analyzed steps in the natural setting using modeling, repeated trials, prompts, and reinforcement; and multiple-exemplars approach to cross-setting generalization (Simpson et al. 1997). The instruction was highly individualized. The first author completed a task analysis for participation in conversation at lunch for each student. Participants were taught each step in the task analysis. Topics of conversation were selected based on the interests of the participants and on the interests of peers. The participants' conversational skills within a given topic were informally assessed, and the task analysis was developed to sequentially teach the steps that were not an existing part of the student's repertoire. The skills were first taught in a 1:1 format, with the student with autism interacting with only the investigator. Then, the skills were practiced with the peer in a small room. Finally, the skills were practiced in the cafeteria setting. The self-monitoring intervention began when the student had demonstrated successful, independent social initiations to peers without prompts from the investigator and a stable trend for the first intervention condition was established.

Self-monitoring

The self-monitoring intervention followed the method proposed by Koegel et al. (1995) and consisted of five steps: operationally defining the target behavior(s), identifying reinforcers, designing or choosing a self-management device and method, teaching the individuals to use the devices, and teaching self-management independence.

For the purposes of teaching self-monitoring to the participants, the target behavior of social initiation was defined as starting a conversation with a friend. Each time a participant began speaking when no one else was talking, they counted it as one initiation.

The investigator taught the participants to use the self-monitoring device (a golfer's wrist counter) in a 1:1 setting. Each participant awarded himself one point for each social initiation. After a brief overview of the procedure, the participants wore the counter and were given examples and non-examples of behavior of social initiation. They were asked to award points for items that met the established definition. Once able to do so with 90% accuracy, the student used the system in the cafeteria setting. The student and the investigator rated the behavior, and the investigator positively reinforced for agreement. The investigator consulted with school staff and parents to identify salient reinforcers for each student, and students were presented with a selection of reinforcers at the end of each lunch period during the training and intervention phases (contingent upon self-monitoring agreement). The required percentage of agreement to obtain reinforcement was systematically increased until the student and investigator reached 90% agreement for three consecutive sessions.

Gradually, adult presence was faded during self-monitoring sessions. The author removed herself from near the table where the participants used the self-monitoring device, while continuing to observe the student's behavior. In the maintenance phase, the conditions approximated the baseline phase in that no self-monitoring procedures, prompting, or reinforcement were provided.

Fidelity of Treatment

The investigator and the research assistant completed an implementation checklist following each observation and instruction session. The checklist items included the use of reinforcers, whether the self-monitoring device was worn, and whether the student self-monitored initiations.

Results

Interobserver Agreement

Interobserver agreement checks occurred in each condition and were calculated separately for each behavior (repetitive motor behavior, social interaction, and social initiations) and for each participant. Percent of agreement and *kappas* were calculated, when the behavior occurred with sufficient frequency to perform the calculation (for the latter). Interobserver agreement data are listed in Table 1. For Stuart, interobserver data were collected on a total of seven sessions of the 28 sessions (25%) in which data were collected. For Anthony, agreement data were collected on six of the 20 total sessions (30%). Agreement data were collected for four of William's 13 sessions (30.7%). The overall mean percentage of interobserver agreement for repetitive motor behavior was 93.67%, with a range of

Table 1 Interobserver agreement

	Repetitive motor behavior			Interaction		Initiations	
	Session	Percent	*Kappa*	Percent	*Kappa*	Percent	*Kappa*
Stuart	6	87	.71	87	.72	100	1
	8	100	1	100	1	100	n/a
	12	87	.72	93	.76	100	n/a
	17	100	1	100	1	100	1
	23	100	1	100	1	100	1
	28	93	n/a	100	1	100	1
	29	93	.86	100	1	93	.86
Average		94.28	.88	97	.93	99	.97
Anthony	6	93	.86	100	1	100	n/a
	12	93	.86	100	n/a	100	n/a
	17	93	.76	87	.73	100	n/a
	23	93	.86	100	1	100	n/a
	24	87	.74	93	.81	100	1
	28	93	.63	100	1	100	1
Average		92	.79	97	.91	100	1
William	12	93	.86	100	1	100	n/a
	17	100	1	100	n/a	100	n/a
	24	93	.84	100	1	93	.86
	28	93	.76	100	n/a	100	1
Average		94.75	.87	100	1	98.25	.93

87–100%. Average *kappa* for repetitive motor behavior was .85, ranging from .63 to 1. The overall mean percentage of interobserver agreement for social interaction was 98%, with a range of 87–100%. *Kappa* for social interactions averaged .95 and ranged from .72 to 1. The overall mean percentage of interobserver agreement for social initiations was 99% for, with a range of 93–100%. Average *kappa* was .95, ranging from .86 to 1.

Intervention Package

The efficacy of the intervention package was evaluated using visual inspection (Kazdin 1982). Changes in level and in trend were compared across conditions and across participants. Research questions are discussed individually below, and each is followed by the line graphs of the relevant data.

Social Initiations

All three participants demonstrated an increase in social initiations from baseline to intervention conditions, and the increases were maintained when the self-monitoring system and reinforcers were removed.

During baseline observations, Stuart rarely initiated social interaction. The percent of intervals in which he initiated to a peer during the five baseline data points ranged from 0% to 13.3%. In contrast, social initiation data during direct instruction ranged from 6.7% to 60% of intervals. Once self-monitoring was introduced, social initiation ranged from 20% to 60%. Stuart made initiations to his target peer and, according to anecdotal notes collected on the data collection sheets, also made social initiations to two other children who were not part of the training. Stuart's gains maintained in the final condition, with social initiations occurring in 33–73.3% of intervals.

Across six baseline observations, Anthony had social initiations on only the first observation when he initiated in 13.3% of intervals. After the first observation, the baseline data had a stable trend with no initiations. Following the peer training and social initiation teaching sessions, Anthony's social initiations climbed in a positive trend from 0% to 40% of intervals. He also initiated to several students in addition to his trained peer. When self-monitoring began, intervals of social initiations were 26.7–46.7% and also continued on a positive trend. Anthony also maintained his increase in social initiations, with all maintenance data points above baseline levels. These ranged from 20% to 40%.

In four baseline observations, William had no social initiations. He spoke, but his statements did not appear to be directed at other students. After social skills instruction and peer training, there was a change in level and in trend for William. His social initiation data ranged from 13.3%

to 40% across four sessions. The positive trend continued in the four sessions when self-monitoring was introduced, where intervals of initiation ranged from 33% to 46.7%. William had some difficulty maintaining these gains, however. He did not initiate on the first maintenance observation and initiated in 60% of intervals.

Significant environmental changes may have impacted social initiations for Stuart and William. At data point 20, Stuart's trained peer was absent, and he initiated social interaction during only 20% of the intervals on that day. At data point 22, he initiated interactions during only 26.7% of intervals. The cafeteria was decorated for Thanksgiving on that day and loud music was played during lunch. Stuart complained to the cafeteria monitor that the noise bothered him, and he put his fingers in his ears. On session 35, students in William's lunch hour were allowed to choose their own seats in the cafeteria for the first time. William wandered the cafeteria with his tray for several minutes before finding a seat near some boys who were not in his class and spent the entire lunch period without talking. When the final maintenance point was collected over a month later, however, William sat and talked with his classmates (Fig. 1).

Social Interaction and Repetitive Motor Behavior

Stuart engaged in repetitive motor behavior during 33–66.7% of intervals during the five baseline observation sessions, and social interaction baseline data points ranged from 13% to 33%. When the peer training was completed and social initiation instruction began, an abrupt change in level and in trend occurred. As repetitive behaviors decreased, social interactions increased. The percent of intervals in which repetitive motor behavior occurred dropped from 26.7% to 6.7%. There was an immediate change in level for social interaction data, as well, which ranged from 46.7% to 100% of intervals in the instruction phase. In the self-monitoring phase, results were mixed. Stuart was engaged in social interaction in 53.3–100% of intervals, and repetitive motor behavior occurred in 0–33% of intervals. Significant environmental changes occurred on two of the days of in the self-monitoring phase. At data point 20, Stuart's trained peer was absent, and he exhibited repetitive motor behavior in 33% of intervals on that day. At data point 22, repetitive motor behavior occurred in 20% of intervals. This data point coincides with changes in Stuart's usual routine and environment, as detailed above. Social interaction maintenance data ranged from 53.3% to 100%. Stuart also continued to engage in less repetitive motor behavior during maintenance probes. Data collected across four probes ranged from 0% to 33% of intervals with some stereotypy.

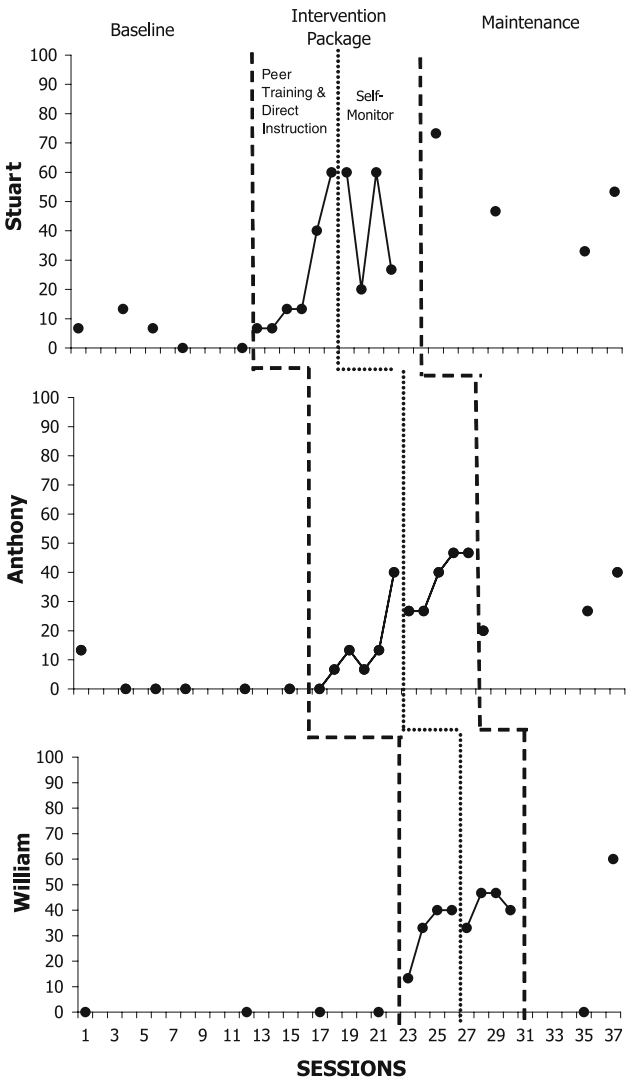

Fig. 1 Social initiations. The percent of intervals during which the participant started an interaction with a peer(s) with whom there has not been an interaction during the previous 5 s

In the six baseline sessions, Anthony's repetitive motor behavior data were variable, ranging from 40% to 93.3% of intervals, while social interaction data were stable and low, ranging from 0% to 13%. In the instruction condition, repetitive motor behavior fell to 0% to 33% of intervals. Social interaction data during instruction ranged from 33% to 80%. The self-monitoring data points had a negative trend as well and ranged from 6.7% to 46.7% of intervals. Three probes of maintenance data indicate that the reduction in repetitive motor behavior continued after the intervention ceased. These data ranged from 6.7% to 26.7%. In terms of the maintenance of social interaction, data ranged from 66% to 100%, with three of the five data points at 100%.

In baseline, there was a steep, positive trend in William's repetitive motor behavior. Across the three

probes, data ranged from 53.3% to 73.3% of intervals. At three of the four baseline data collection points, social interaction occurred. These data ranged from 0% to 46.7%. In the social skills instruction phase, repetitive motor behavior ranged from 6.7% to 26.7%. In terms of social interaction, a large change in level occurred with instruction phase; these data ranged from 86.7% to 100%. Likewise, data on repetitive motor behavior during self-monitoring were well below baseline levels and ranged from 6.7% to 20% of intervals. Social interaction in the self-monitoring condition ranged from 86.7% to 100%. Repetitive motor behavior did not change in maintenance, after more than a month without intervention. The two maintenance probes for repetitive motor behavior were 13.3% and 20%. Social interaction, in contrast, was variable in the maintenance condition. William engaged in social interaction during only 13.3% of intervals at session 35. As noted above, the lunchtime procedures changed significantly on this date. The final data point for social interaction was at 93.3% (Fig. 2).

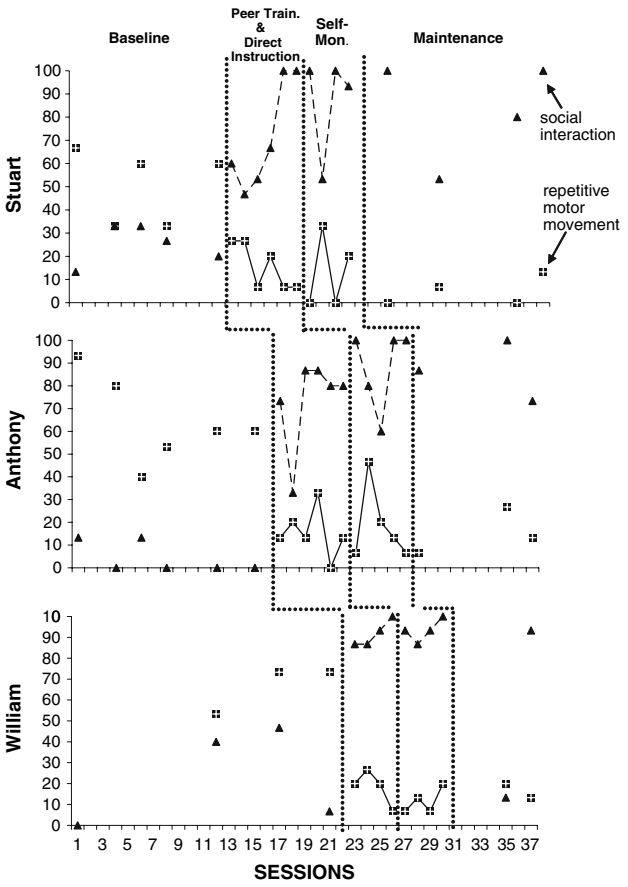

Fig. 2 Collateral behavior change. The percent of intervals during which the participant engaged in repetitive motor behavior and social interaction

Fidelity of Treatment

The investigator and research assistant completed a fidelity checklist following 94% of the sessions. Checklists were customized to each condition of the study, and the items that should be endorsed changed with each phase of the study. For example, during baseline, no reinforcers were given and the participant did not wear the wrist counter. However, those components were required in the self-monitoring phase. According to the checklist, the interventions were implemented with 100% accuracy.

Social Validity

The assessment of the social validity of the intervention was based on several factors: a social validity measure, the students' IEP goals, and anecdotal information. These are discussed in terms of each area of social validity: the goals of treatment, the treatment procedures and the outcomes of treatment (Gresham and Lopez 1996; Wolf 1978). For each participant, goals in the IEP were consistent with the aims of this study. Additionally, the teachers for all three participants and the mothers of two agreed that improvement in social initiations and interaction with peers were important goals. William's mother did not return the social validity form and did not meet with the investigator to discuss the outcome of the study. Both mothers and all teachers who completed the social validity measure before the study began indicated that they thought it was a good idea to teach their child/student to self-monitor his own social initiations. Likewise, all marked "Agree" for an item stating that other positive changes may occur when their child/student begins to manage his own behavior.

At the end of treatment, teachers completed the social validity measure and once again responded that the self-monitoring intervention was a good idea. Parents, because they were not at school to observe noted changes, were not required to do so. Stuart's teacher agreed that his social interaction increased and his repetitive motor behavior decreased with his participation in the study. When the intervention ended, Stuart's classroom teacher approached the investigator and asked for more information about the intervention technique and asked for ways she could use self-monitoring in her classroom. Additionally, the investigator received an unsolicited email from Stuart's mother noting improvements and a developing friendship with his trained peer. Anthony's teacher also agreed that his social interaction increased and his repetitive motor behavior decreased with his participation in the study. William's teacher, who did not observe him during the lunch period, slightly agreed that social interaction increased. She marked neutral on whether or not repetitive motor behavior

was reduced. However, when the intervention ended, William's teacher telephoned the investigator and asked whether she would consult with the school social worker who was planning a social skills group that would include William. She mentioned that the techniques used in the study would be helpful in the group.

Discussion

In a multiple baseline design across three participants, children with autism were taught in a one-to-one direct instruction format to initiate social interaction their peers. Then, the participants were taught to keep track (self-monitor) their initiations using a golfer's wrist counter. The intervention package successfully increased the participants' social initiations, and as social interaction increased collateral reductions in repetitive motor behavior were observed.

Positive effects were noted over a month after the intervention ended, although it is important to note that only 2–4 data points were collected for each participant during the maintenance phase. It is also difficult to fully understand the extent of generalization. Social validity data indicate some degree of carryover, but no formal measure of generalization was collected. (Of note, in the original research plan included collection of generalization data during recess. However, months of inclement weather caused the school to change their schedule and cancel several recess sessions.)

It is not surprising that instruction in specific social skills led to an increase in social initiations. Explicit instruction of social skills is established as an effective means of teaching new social skills to children with autism (Belchic and Harris 1994; Kamps et al. 2002). The participants very quickly learned to initiate to their peers, perhaps this is because they already possessed most of the skills required to initiate. They were very verbal and capable of making declarative statements.

The peer-training component likely played a key role in the success of the instruction phase. Teaching the peers to be more responsive to the participants may have created an environment that helped support the intervention. Without positive peer responses, it is unlikely that the same increase in social initiation and social interaction would have occurred. Even when reinforcers were faded, social behavior continued, suggesting that the interactions became a natural community of reinforcement (Stokes et al. 1978). The social behavior of the children with autism was under the control of the naturally occurring reinforcer of interaction with peers, rather than the extrinsic reinforcers originally provided by the investigator. This well-documented phenomenon, also known as entrapment, provided opportunities for continued use and elaboration of recently acquired skills (McConnell 1987).

In part, the improvements in social initiation and interaction may have occurred because the children were provided with a clear framework for how to conduct themselves during an unstructured, previously ambiguous period. It also seems that social interaction became more reinforcing for the participants as the study progressed. In baseline, little social interaction and almost no initiations occurred. When peer training and direct instruction were provided, along with tangible reinforcers, social behavior increased. The maintained increase in social initiations and interactions is also not surprising and may be attributed, in part, to the self-monitoring component of the intervention. In social cognitive theory, self-monitoring is considered to be a subfunction of self-regulation, the basis for purposeful human action (Bandura 1991). In order to self-monitor, an individual must pay adequate attention to his or her own behavior, the conditions under which these behaviors occur, and the immediate and distal effects that are produced. When individuals self-monitor, they attend to select aspects of behavior on which they may ordinarily not focus. Changing the focus of attention, in this case, allowed the participants to attend to their social behavior. Before the intervention, peer interactions may have been largely ignored by the children. When the self-monitoring system was removed, the shift of attention to social behavior may have remained. This could account for the observed maintenance effects.

The collateral reduction in repetitive motor behavior is consistent with the findings of other studies in which social interaction increased (Lee and Odom 1996; Lee et al. 2007; Lord and Hopkins 1986). There are several reasons why this may have occurred. As Lovaas et al.'s (1987) theory of repetitive motor behavior suggests, children with autism may use stereotypy to manage their own level of perceptual stimulation. The participants in this study may have received competing stimulation when engaged in social interaction, and therefore, engaged in less repetitive motor behavior. Social interaction may have become reinforcing, due to the stimulation it provided. This theory fits well with the high levels of social interaction that maintained long after tangible reinforcers were discontinued. Once they had the skills to interact with peers, the participants may well have found social interaction more motivating.

A second possibility is that social interaction is incompatible with repetitive motor behavior. Because it does not come easily to a child with autism, engagement in social interaction likely required their full attention. The participants may have found it difficult to attend to any other behavior while talking to their peers. Children with autism have difficulty disengaging attention once it is captured by stimuli (Landry and Bryson 2004). It is possible that once

the peers were the focus of the target children's attention it became more difficult to shift attention back to stereotypy. Thus, they remained engaged with their peers. Another possibility is that the collateral behavior change occurred because repetitive motor behaviors have communicative qualities that become unnecessary as other means of communication increase (Carr and Durand 1985). It is possible that as they found ways to verbally interact with their peers, the participants found verbal strategies more efficient and/or more effective than repetitive motor behavior for interaction.

Unlike some studies that have examined repetitive motor behavior (e.g., Shabani et al. 2001), this investigation did not include a functional analysis prior to intervention. In future studies, a functional analysis may have provided more information on which to base hypotheses about why the collateral behavior change occurs. While information about the function of repetitive motor behavior for the participants would be interesting, the primary focus of this study was on the promotion of social initiation and interaction with peers. The collateral change in repetitive motor behavior was an added benefit.

The use of tangible reinforcers did not seem entirely necessary and may have served as a distraction. The peers would occasionally ask the investigator what prizes she had when she arrived in the cafeteria; more often, however, peers would refuse reinforcers. Other studies have documented that adult-provided reinforcers may not be necessary for peer-mediated interventions (Odom et al. 1985). In this as well as other studies for promoting social interaction of children with autism, natural reinforcers appear to be effective in supporting and maintaining social performance (Kennedy and Itkonen 1996).

These findings may be less applicable to individuals with autism whose communication ability is less developed or those with lower cognitive ability. For children with more severe communication and social deficits, the instruction phase may need to be more intensive and would likely take much longer. They may not possess some of the skills that were already in the repertoire of these participants, and more time might be required to explicitly teach the steps of the task analysis. Non-verbal means of initiating with peers may also be necessary.

Further studies of efficient interventions that target multiple behaviors would help provide parents, school staff, and other professionals with effective means of addressing behavior problems and teaching skills. Social interventions are especially important because the key to accommodating students with autism in public schools is the provision of social and behavioral programming to develop meaningful participation with typical peers (Koegel et al. 1996). Studies conducted within natural school contexts are especially important (Volkmar et al. 2004).

Expansions on the current study in future research might address more directly the generalization of social initiations. A component analysis of this treatment package would provide useful information about the efficacy of each element. Interventions that develop critical skills while also reducing problem behavior are both efficient and positive. The further development of such methods will offer parents, teachers, and others who work with children with autism economical and effective means of increasing positive behavior while reducing problem behaviors.

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