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ORIGINAL PAPER

Effects of Circumscribed Interests on the Social Behaviors of Children with Autism Spectrum Disorders

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Abstract This study compared the effects of circumscribed interests (CI) to less preferred (LP) tangible stimuli on the social behaviors of three children with autism spectrum disorders (ASD). Based on single subject design methodology, the CI experimental sessions resulted in longer durations of target-child initiated social interactions in comparison to LP sessions. In addition, latency of participant's initial social bids to peers was decreased when CI were present. The results suggest that embedding CI into dyadic play situations with typical peers can be used to increase the social behavior children with ASD direct toward typical peers. Future research should examine the specific environmental conditions that must be present in naturalistic settings to facilitate generalization of social behavior.

Keywords Autism · Circumscribed interests · Pervasive developmental disorders · Restricted interests · Repetitive behaviors · Structural analysis

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Introduction

There has been an increased emphasis among researchers in the field of autism to study the diagnostic category of restricted, repetitive behaviors (RRB). This increased emphasis is to understand the ontogeny and etiology of RRB in autism as well as their relation to other core features of the disorder, i.e., social and communication deficits. Recent studies have shed light on the prevalence and/or topography of RRB among individuals with autism spectrum disorders (ASD) (Bodfish, Symons, Parker, & Lewis, 2000; Militerni, Bravaccio, Falco, Fico, & Palermo, 2002). Indeed the third diagnostic category of RRB appears to be just as diverse as the individuals with ASD who display those behaviors (see Lewis & Bodfish, 1998). Turner (1999) categorized the continuum of RRB under two broad constructs, referred to as higher versus lower order behaviors. Factor analyses based on the RRB subdomain of the Autism Diagnostic Interview-Revised (ADI-R) (a caregiver interview diagnostic measure; Lord, Rutter, & Le Couteur, 1994) have found empirical support for a bi-dimensional classification (see Cuccaro et al., 2003; Szatmari et al., 2006). In general, *lower order* behaviors appear to be correlated with lower developmental levels and simple repetitive actions (e.g., stereotypies) and *higher order* with more complex RRB (e.g., circumscribed interests) and higher cognitive abilities (see Turner, 1997).

Researchers have put forth various conceptual or theoretical explanations to account for the observed heterogeneity of repetitive behaviors in ASD, including neurological abnormalities in the frontal lobes or cerebellum (Lewis, Baumeister, & Mailman, 1987; Pierce & Courchesne, 2001), and intact (working

memory or response inhibition) as well as deficient (cognitive flexibility) executive functions (Lopez, Lincoln, Ozonoff, & Lai, 2005; Ozonoff & Jensen, 1999; Turner, 1997). Operant learning theorists have focused less on the etiology or underlying primary deficits of RRB and more on the reinforcer(s) currently maintaining the behavioral excesses (Lovaas, Newson, & Hickman, 1987; Reese, Richman, Belmont, & Morse, 2005; Symons, Sperry, Dropik, & Bodfish, 2004). Both perspectives may be relevant for intervention purposes. Indeed as Symons et al. points out the underlying cause of the RRB may or may not be related to the environmental conditions currently maintaining the display of that behavior. Because of the relationship Epstein, Taubman, and Lovaas (1985) found between the display of higher level RRB and school outcomes in a small sample of children with autism, they advocated the shaping of higher level repetitive behaviors to replace lower level ones.

Circumscribed Interests

Circumscribed interests (CI) are conceptualized as the interests or preoccupations of individuals with ASD that become unusual in their intensity and/or focus. These interests appear to increase in intensity over the individual's life span (South, Ozonoff, & McMahon, 2005) and may interfere with the development of peer relationships because the individual only cares to converse with others about his/her interest (Attwood, 1998). CI are postulated to lie at the higher end of the repetitive behavior continuum and are thought to be more prevalent in individuals with higher functioning autism (HFA) (Epstein et al., 1985; Turner, 1999). In reviewing the literature on CI, at least four attributes of those interests were found (a) accumulation of mass amounts of information or facts (Attwood, 1998; South et al., 2005), (b) difficulty redirecting individual from physically interacting with or conversing about the interest (Adams, 1998), (c) duration of fascination with the interest (South et al., 2005), and (d) intensity of focus (individual spends a great deal of free time engaging with the interest) (Adams, 1998). Without intervention, these interests may not naturally develop into functional hobbies or adaptive skills. Prior behavioral intervention studies on the CI of children with ASD can be categorized into consequence- or antecedent-based intervention. Thus, access to the CI either was provided on the contingent occurrence of more appropriate behavior (consequence-based) or embedded into structured activities to motivate the child with ASD to engage in appropriate behavior during those activities (antecedent-based). The embedded use of CI also is consistent with the structured teaching intervention approach pioneered at Division TEACCH (Mesibov, Shea, & Schopler, 2005).

Through a series of studies using single subject methodology, Charlop, Kurtz, and Casey (1990) and Charlop-Christy and Haymes (1996, 1998) found the consequence-based use of CI (referred to as obsessions or perserverations) to be more effective than food reinforcers at increasing the task-related behaviors of school-aged children with ASD. The majority of previous research in the field of applied behavior analysis (ABA) has addressed the behavioral excesses of individuals with ASD using consequence-based approaches (Horner, Carr, Strain, Todd, & Reed, 2002). Although these approaches have been demonstrated to be effective, at times, negative side effects (e.g., extinction bursts) can occur. Antecedent interventions attempt to circumvent negative side effects by maximizing contextual variables in the environment associated with prosocial behavior, or simply diminishing contextual variables that contribute to problem behavior (Carr, Carlson, Langdon, Magito-McLaughlin, & Yarbrough, 1998). Adams (1998) employed such an approach by embedding the CI of five preschool-aged children with autism into pre-academic tasks (three per child) to determine their effects on the primary-dependent measure of task score (number of task items correctly completed in a limited amount of time). The researcher found quite positive effects on the work behavior of two participants and somewhat variable data for the remaining participants.

Baker, Koegel, and Koegel (1998) and Baker (2000) authored the only two published studies found that used the CI of children with autism as antecedent-based interventions to increase their social behaviors with peers and siblings, respectively. Baker et al. identified the CI of three school-aged children with autism via interviews with their classroom teachers/aides and parents in addition to direct observation of the participants' play in their school settings. For the item to be deemed a CI, all parties had to agree the child ''abnormally perseverated'' on the item. Once identified, the researchers incorporated the child's CI into individualized, but cooperative games to evaluate its effect on the participant's display of appropriate social behaviors. Specifically, Baker et al. compared the percentage of time children with autism engaged in appropriate play during lunch and recess activities, which did not include their CI, to free play outdoor games modified to include the special interest. The researchers found marked increases in the children's displays of social behaviors and maintenance of those behaviors over time. In the latter study, Baker

compared three participants' play during games with older siblings that did or did not include their CI. With the CI games, she found generalization of social skills across clinical and home settings. The authors speculated that CI may be powerful change agents because they are intrinsically reinforcing; such an explanation is in line with operant theory. However, in both studies competing variables may have affected intervention outcomes. It is possible that typical peers or siblings began to direct more social behavior toward the children with autism during the CI-based games because the games appeared more enjoyable for the participant, and therefore changes in typical peers' behaviors in the CI versus non-CI games may have mediated intervention effects. Currently, two of the primary problems associated with CI intervention studies are (a) lack of systematic identification of the CI (typically identified via informant report only), and (b) lack of experimental assessment procedures to demonstrate a clear, functional relationship between the presence of the CI and changes in participant behavior.

The purpose of the present study was to evaluate the effects CI have, when used from an antecedent-based approach, on the peer-related social behaviors of young children diagnosed with ASD. The research questions addressed were (1) What is the effect of the presence of a CI item in comparison to a less preferred (LP) tangible stimulus on the social behaviors of three young children with ASD; and (2) Do children with ASD initiate social bids to peers sooner in the presence of a CI in comparison to a LP tangible stimulus?

Method

Participants

The research team obtained university-approved, informed consent from the caregivers and teachers of participating targeted children and their peers. The three participants were diagnosed with ASD by independent agencies unaffiliated with the present study. The Childhood Autism Rating Scale (CARS) was used for diagnostic confirmation (Schopler, Reichler, DeVellis, & Daly, 1980). Inclusion criteria for study participants were (a) use of at least 2–3 word utterances to express basic wants and needs, (b) ability to initiate or respond to peers' social bids using gestural or verbal forms of communication, (c) display of low levels of appropriate or high levels of inappropriate social behaviors, and (d) display of high levels of physical engagement with or discussion of a circumscribed interest. Children with known secondary causes of autism were excluded from the study (e.g., fragile-X syndrome). Caregiver and teacher interviews, direct observations of the participants in their respective classrooms, and reviews of school records confirmed the aforementioned criteria.

In addition, the Social Skills Screening instrument (adapted from Brown, Odom, & Buysee, 2002), a paper and pencil measure, was used to collect pre-experimental (i.e., pre-baseline) data on the occurrence of target children's social behaviors. In vivo observations were conducted on the percentage of intervals during a 10-min observation session the target child engaged in social behavior with classroom peers. Trained graduate students observed the children 2–3 days per week across three to five classroom-based activities (e.g., snack, art) identified by their teachers as conducive to social interactions. Six to ten data collection sheets were completed per participant (two per activity area) for a total of 60–100 min of direct observation time.

Jason

Jason, a Caucasian male, was 5 years, 8 months at the start of the study. He participated in a full inclusion kindergarten classroom with assistance from a full-time aide. Jason was diagnosed with PDD-NOS at the age of three by a pediatric neurologist. According to teacher and parent interviews, his social-communicative skills included the ability to initiate and respond through gestures and verbal language (three to four word utterances). His social behavior deficit was the low rate of initiations to peers. Jason's standard score on the Vineland Adaptive Behavior Scales was 63, indicating mild impairments in adaptive functioning. His CARS score was 33.5, indicating a mild/moderate degree of autism. Jason was observed using the Social Skills Screening Instrument during the following classroom activities to collect pre-baseline data: manipulatives/blocks, rule-based games, pretend play, and sensory-based play; his highest percentage of social behavior occurred during manipulatives/blocks (33%), and lowest during sensory play (6%).

Allen

Allen, a Caucasian male, was 5 years, 7 months at the start of the study. He participated in a full-inclusion, multi-age classroom (kindergarten-second grade) with assistance from a full-time aide. Allen was diagnosed with PDD-NOS at the age of three by a physician using DSM-IV criteria. According to teacher and parent

interviews, his social-communicative abilities included the use of complete sentences to initiate and respond to peers, and the ability to engage in some cooperative play. His social behavior deficit was his low rate of peer-related social interactions. No IQ score or equivalent was found in Allen's school records; however, his teacher reported that his academic performance was comparable to that of his typically-developing, classroom peers. Allen's CARS score was 25.5, placing him in the non-autistic range. Because the CARS' Scale may not be as sensitive in the diagnosis of children on the higher functioning end of the autism spectrum (Stella, Mundy, & Tuchman, 1999), Allen was included in the study based on the physician's diagnosis using established criteria. Allen was observed during the following activities: books, indoor free play, music, and outdoor play; his highest percentage of social behavior occurred during outdoor play (18%), and lowest during music (0%). His low rates of social behavior also confirmed his appropriateness for the study.

Jin

Jin, an Asian male, was 5 years, 3 months at the start of the study. He participated in a full-inclusion preschool classroom without the support of an aide. Jin was diagnosed with PDD-NOS at the age of four by a pediatrician. According to teacher and parent interviews, his social-communicative skills included the ability to use gestures and verbal language (three to four word utterances) to initiate and respond. His social behavior deficit was the low rate of social initiations to peers. According to the Developmental Profile-II, Jin's IQ equivalent score was 82. His CARS score was 32.5, indicating a mild/moderate degree of autism. Jin was observed during the following activities: cognitive activities (e.g., reading time), manipulatives/blocks, sensory-based play, and snack; his highest percentage of social behavior occurred during snack (16%) and lowest during sensory play (5%).

Settings, Therapists, and Materials

The present study involved two primary phases (1) assessment and (2) structural analysis (SA). SAs are a type of experimental assessment method that allow for the systematic manipulation and comparison of antecedent variables that set the occasion for the occurrence of behavior (appropriate or inappropriate) (Axelrod, 1987; Conroy & Stichter, 2003; Peck, Sasso, & Jolivette, 1997). Typically, a series of contrasting conditions are compared (e.g., high- versus low-structured tasks) during brief probes (5–10 min) to evaluate their effects on participant behavior. Because contrasting conditions are alternated until clear differences in the data emerge, a functional relationship can be drawn between the antecedent(s) (independent variable) and its affect on participant behavior (dependent variable).

Each primary phase also involved secondary phases that will be discussed in experimental procedures. The first author used a ''pull-out'' model to conduct the experimental sessions whereby the target child and one to two peers were taken to a separate classroom, which was an adjoining unoccupied room. Due to logistical constraints, the first author conducted Jin's sessions in his regular classroom; however, the setting difference across the three participants did not affect study outcomes. Sessions occurred during teacher-identified times deemed appropriate for pull-out services and/or social interaction. The first author served as the primary therapist in the study; however, trained graduate students coded each videotaped session using Dell Personal Data Assistants (PDA) equipped with Tap-It (Tapp, 2003), a software program designed to code real time behavioral observations.

Experimental Procedures

All experimental sessions in each phase were 5 min in duration. On average, sessions were conducted 2–3 days per week and took 3–4 weeks for each participant to complete both study phases.

Assessment Phase

The assessment phase consisted of two subphases (a) descriptive assessment and (b) multiple stimulus preference assessment. The primary purpose of both subphases was to systematically identify the participants' CI.

Descriptive Assessment

Descriptive assessment refers to a set of procedures for assessing behavior–environment interactions in the natural setting without manipulating the variables suspected of influencing those interactions (Mace & Lalli, 1991). The first author conducted separate interviews with the teacher and/or classroom aide and one of the child's parents (for all participants, the mother completed the interview) to determine the circumscribed interest. Two parties (e.g., teacher and mother) had to independently identify the item to deem it the CI (Baker, 2000; Baker et al., 1998 used similar criteria). Interview questions addressed the

intensity and duration of the CI to differentiate it from the child's other, albeit less-encompassing interests. It is worth noting that each parent independently stated the child's CI began around 2 years of age.

Multiple Stimulus Preference Assessment

This phase allowed the first author to experimentally verify the participant's circumscribed interest. The verification process was accomplished by comparing the duration of the participant's physical engagement (in number of seconds) with his CI when simultaneously presented with six alternative tangible stimuli. The first author identified six classroom toys the child appeared to enjoy playing with via teacher interviews and direct observations of the child during unstructured play times (see Table 1 for a complete list of items included in each child's preference assessment). Adapted from the work of Roane, Vollmer, Ringdahl, and Marcus (1998), the specific procedures followed to conduct the multiple stimulus preference assessments were (a) brought the child into a separate room or area of the classroom with the seven toys (including the CI) equally-spaced on the floor in a semi-circle, (b) demonstrated to the child how to manipulate each item, (c) removed the child from the semi-circle (~1–2 ft away), and (d) instructed the child that he was allowed to play with any of the items. For each participant, a series of three consecutive sessions were conducted. To validate the CI, the participant had to engage with (physically touch) that item the longest duration of time (out of a total of 5 min per session) in two of three (67%) experimental sessions. Because the participants only touched their CI, the first author identified the LP items that were to be used during the subsequent SA phase by asking the target child (all children were verbal) the following question: ''What other toy [besides the CI] would you like to play with?'' The CI items identified were Thomas the Train™ (Jason and Allen) and a toy dump truck (Jin). The LP items identified for the participants were fluorescent magnets (Jason), unifix cubes (Allen), and wooden, construction blocks (Jin).

Table 1 Items included in multiple stimulus preference assessments

	Circumscribed interest items	Less preferred items
Jason	Thomas the Train™	Children's book Dinosaur Fluorescent magnets Link chains (manipulatives) Plastic insect Regular toy train
Allen	Thomas the Train™	Children's book Counting bears Matching cards (game) Pick-up sticks (game) Plastic fish Unifix cubes
Jin	Toy construction truck	Bristle blocks Large, wooden blocks Legos Plastic, pretend people Small, colored blocks Toy car

Structural Analysis

The SA phase consisted of two subphases (a) choice condition, in which the CI and LP item(s) were simultaneously presented, and (b) an alternating treatment (AT) condition, in which the items were presented in a randomly alternating manner. During the choice condition, two typical peers from the target child's classroom participated. During the AT condition, the first author selected one of the peers from the choice condition to participate. For both conditions, sessions continued until the participant's social behavior data in the CI versus LP sessions showed clearly differentiated patterns upon visual inspection of the graphed data.

Choice Condition

The choice condition served two purposes (1) provided further validation of the participants' CI, and (2) preliminary evidence of the effects of those interests on their social behaviors with peers. The specific experimental procedures involved in the choice conditions were (a) taped off an area of the room measuring $5' \times 6'$ and divided the squared area into two equal halves; (b) had a classroom peer sit in each of the halves holding the CI or LP item; (c) instructed the peers to respond to all target child initiations, but to avoid initiating (to control for peer initiations as a competing antecedent variable); (d) had the target child stand on the edge of the center line dividing the square to provide him a choice of playing with the peer holding the CI item or the peer with the LP item; (e) prompted participant, if needed, to appropriately ask peer for the CI or LP item; and (f) returned the target child to the center line every 30 s to make another choice. Validation of the CI occurred if the child chose to play with the peer holding that item at least 67% (two of three) of the time averaged across three consecutive sessions. In order to control for confounding

variables, the first author counterbalanced both the order the CI and LP items were mentioned by him when giving the target child a choice, and the peers who held those items. No demands or corrections for play behavior were given. In addition, the only consequences provided for target children's initiations were the contingent responses of peers and those were provided irrespective of the child's choice (i.e., choosing to play with peer holding CI or LP item). During the SA phase, if the peer socially initiated or failed to provide a contingent response for a target child initiation, the experimenter verbally reminded the peer of the rules.

Alternating Treatment Condition

The purpose of the AT condition was to experimentally evaluate the effects of the CI in comparison to LP items on participants' social behaviors. The specific procedures involved in the AT conditions were similar to the choice condition with the following exceptions: (a) no masking tape was used to demarcate the play space; (b) only one peer was present; (c) the peer held the CI or LP item with a duplicate item placed ~2–3 ft across from the peer; and (d) the target child was given a choice (at the beginning of each session only) of playing alone with the CI or LP item, or with the peer who possessed a duplicate item. Procedures C and D were modified for Jason because he engaged in perserverative behavior during the choice conditions. Thus, when Jason was asked to choose between the CI and LP items, he perserveratively chose the items in the same order each time. In order to avoid this behavior during the AT condition, only one item (LP or CI, depending upon the session) was present, and this item was in the peer's possession until Jason initiated. In comparison to the choice condition, no demands or corrections for social play behavior were given to any participant or peer.

Dependent Measures

The percentage of intervals the target child chose the CI versus LP item served as the primary dependent measure during the choice conditions. The percentage of time the target child and peer engaged in social interactions and the amount of session time that elapsed before the target child first initiated to the peer (measure of latency) were the primary dependent measures for the AT conditions (see Table 2 for a complete list of behavioral codes and their respective operational definitions).

Interobserver Agreement

Prior to data collection, behavioral coders established interobserver agreement (IOA) on both the dependent and independent measures. During the multiple stimulus assessment phase, IOA was calculated using the following formula for duration behavior: Smaller Duration/Larger Duration × 100. The Multiple Option Observation System for Experimental Studies (MOOSES) (Tapp, 2002) was used to calculate IOA for the SA subphases. MOOSES is a behavioral software program that uses a time-based window to calculate IOA on frequency and duration behaviors. Agreement for participant and peer behaviors was defined as two independent observers scoring the same code within a ±5 s window of time. Any deviation from this criterion was counted as an error. Agreement for the independent variables (i.e., CI versus LP stimulus) was defined as two independent observers scoring the same code for the same amount of time. During the study, IOA was calculated for the following range of sessions across participants and study phases: 33–44% of the sessions for the assessment phase and 26–36% of the sessions for the SA phase (see Table 3 for each participant's IOA across study phases and subphases).

Treatment Integrity

The experimenter collected treatment integrity data to measure the extent to which competing antecedents (peer initiations) or consequences (peer responses) influenced target child outcomes. To evaluate peer responses to target child initiations, treatment integrity data were collected on the probability of the peer responding at an equal ratio during both the CI and LP sessions. Conditional probability values range from 0 [indicating a target behavior (i.e., peer responses) never followed a given behavior (i.e., target initiations)] to 1 (indicating a target behavior always followed a given behavior) (Yoder & Feurer, 2000). In addition, the first author collected data on rate of peer initiations.

Social Validity

An expert in ASD from the University of Florida Center for Autism and Related Disabilities (CARD), naïve to experimenter expectations, viewed 10 min video clips of randomly selected footage of the participants during CI (5 min) and LP (5 min) sessions of the AT condition to determine social validity. An expert was selected to determine social validity to obtain an impartial measure of therapeutic outcomes.

Table 2 Behavioral codes and operational definitions

Positive initiations	Positive initiations were defined as any verbal or gestural behavior directed toward a peer in an attempt to obtain peer attention, access to a peer's objects/activities, or to elicit a social response by providing the peer assistance, comfort, or affection (e.g., complimenting, offering materials, or hugging)
Positive responses	Positive responses were defined as any verbal or gestural behavior that the child physically engaged in to overtly acknowledge an initiation within 3 s of that initiation. This may include appropriately declining an initiation and ''looking'' at the peer if the child clearly orients himself toward the initiator after the occurrence of a peer initiation
No response	No response was defined as the child either knowingly or unknowingly ignoring the initiator
Social interactions	An interaction was coded after a sequence of three social behaviors occurred between the target child and a peer; the interaction began with the third behavior in the sequence (i.e., initiation-response-interaction). A positive interaction was coded if all components of the initial and subsequent behavioral sequences were positive, and a negative interaction was coded if any of the social behaviors became negative in nature

Table 3 Participant IOA by phase/sub-phase

Phase	Preference assessment	Structural analysis				
Sub-phase		Choice Condition	Alternating Treatment Condition			
Dependent measure	Duration of engagement	% of intervals	% of social interaction		Rate of initiations	
	Mean	Mean	Mean	Range	Mean	Range
Allen	100	100	100	100	100	100
Jin	100	100	98	97–100	83	67–100
Jason	100	100	98	95–100	83	67–100

The expert completed Likert scales to indicate the degree of appropriate and inappropriate social behavior displayed by the participant.

Results

Percentage of Target Child Choices

The percentage of target child choices is based on 30-s intervals of time during the 5-min choice condition. Thus, each child was able to make six choices during one session. Percentage of target child choices was calculated using the following formula: number of times the target child chose the CI item (or LP)/total number of choices × 100. Means and ranges across the choice condition are reported.

Choice Condition

As Fig. 1 displays, the mean percentage of intervals Jason chose the CI was 52% (range: 43–57%); similarly, the mean percentage for the LP item was 48% (range: 43–57%). In contrast, Allen chose to play with the peer holding the CI item 100% of the time, and mean percentage of intervals for Jin averaged 94% for CI (range: 83–100%) and 6% (range: 0–17%) for LP sessions.

Percentage of Social Interactions

Percentage of time engaged in social interactions was calculated using the following formula: number of seconds target children and peers engaged in social interactions/total duration of session (300 s) × 100. Means and ranges across the sessions are reported. All participants only engaged in positive peer-related social interactions.

Alternating Treatment Condition

Across the three participants, average percentage of time engaged in peer-related social interactions was

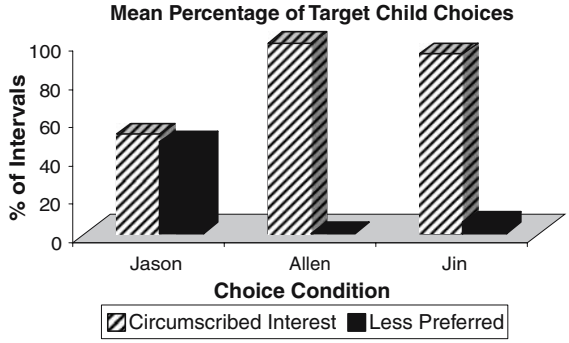

Fig. 1 Mean percentage of target children's CI versus LP choices during the choice condition

substantially higher during sessions that included their CI. During the CI and LP sessions, social interaction data for Jason averaged 48% (range: 0–97%) and 0.3% (range: 0–2.3%), respectively. As indicated in Fig. 2, no social interactions occurred during the majority of his LP sessions. Allen's mean percentage of social interactions was 48% (range: 24–73%) in the CI and 12% (range: 0–39%) in the LP sessions. Social interaction data for Jin in the CI sessions averaged 28% (range: 11–62%) and 0% in the LP.

Latency to First Target Child Initiation

Latency data during the AT conditions of the SA phases were used to determine if the target child initiated to the peer sooner when playing with the CI versus the LP item. Latency was determined by the amount of session time that elapsed before the target child initiated to the peers. Means and ranges (in number of seconds) are reported.

As can be seen in Fig. 3, the three participants either initiated to the peer sooner in the CI sessions or never initiated to the peer during the LP sessions. Jason's average latency time to his first peer initiation was 3 s (range: 2–6 s) for the CI sessions and 14 s (range: 1–89 s) for LP. Average latency time for Allen was 26 s (range: 7–54 s) and 99 s (range: 9–204 s) for the CI and LP sessions, respectively. Mean latency for Jin was 41 s (range: 9–137 s) during the CI sessions; however, Jin did not initiate to the peer during the LP sessions.

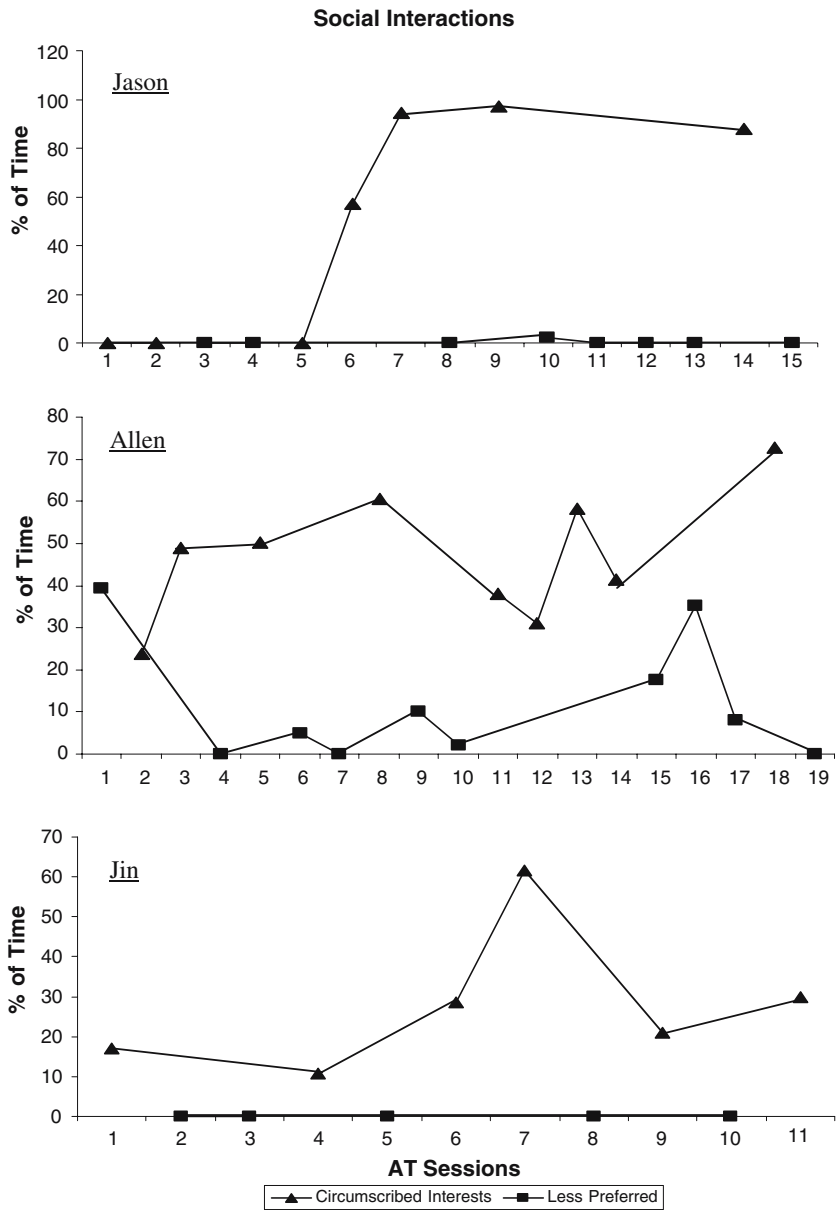

Fig. 2 Percentage of time engaged in social interactions during alternating treatment sessions. Top panel (*Jason*), middle panel (*Allen*), bottom panel (*Jin*)

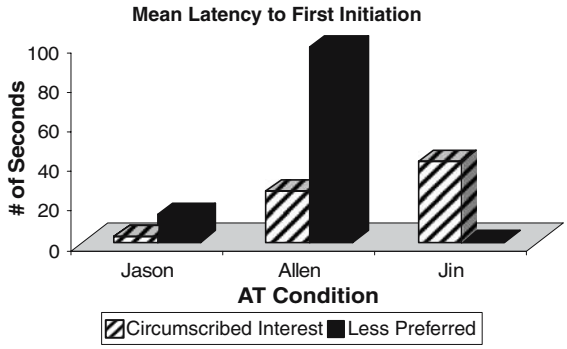

Fig. 3 Mean latency to first initiation for target children during alternating treatment condition

Treatment Integrity

Two types of treatment integrity data are reported: (a) probability of peer responses and (b) rate of peer initiations. Rate of peer initiations was calculated using the following formula: frequency of peer initiations/total number of minutes per experimental session (5 min) × 1 min. Means and ranges are reported for rate of peer initiations.

Conditional Probability Values

During Jason's AT condition, the probability of the peer responding across the combined CI sessions was 1.00 and the probability of responses during the LP sessions also was 1.00. The probability of the peer not responding during those sessions was 0.00 for both the CI and LP sessions. For Allen, peer response and no response conditional probability data for the CI sessions were 0.89 and 0.11, respectively, and for the LP, 0.88 and 0.12. For Jin, peer response and no response probability data in the CI were 1.00 and 0.00, respectively. Peer response probability data are not reported for Jin's LP sessions because no target child initiations occurred. The data show peer response rate did not vary based on the presence of the participant's preferred toy (i.e., the CI).

Rate of Peer Initiations

Jason's mean rate of initiations from peers during the AT conditions averaged 0.05/min (range: 0–0.2/min; CI) and 0/min (LP), respectively. For Allen, mean rate of peers' initiations in the CI sessions was 0.02/min (range: 0–0.2/min) and 0/min for the LP; and for Jin, the means were 0.04/min (range: 0–0.2/min; CI) and 0.02/min (range: 0–0.2/min; LP), respectively. This indicated the target children most likely initiated the vast majority of social interactions.

Social Validity

For social validity data, Likert values ranged from 1, indicating inappropriate social behavior to 6, indicating appropriate behavior by the target child. Means and ranges are reported. The expert's response to question one that inquired about the *appropriateness of the target child's play* with the peer averaged 5 (range: 5) when the expert viewed video of the children in the CI sessions and 2 (range: 1–2) when she viewed video of the children in the LP sessions. The mean response to question two concerning the *inappropriateness* of the child's play was 2 (range: 2) for the CI and 5 (range: 5–6) for the LP conditions. The expert's mean response to question three that addressed the *frequency* of the child's play with the peer was 5 (range: 5–6) and 1 (range: 1–2) for the CI and LP sessions, respectively. The final question dealt with the target child's *enjoyment*; the expert's mean response was 5 (range: 5–6) for the CI and 1 (range: 1–2) for the LP sessions.

Discussion

During the choice conditions of the SA phase, two of three participants consistently selected their CI versus LP tangible item when those items were presented simultaneously. Although one participant repetitiously alternated his choices when presented with the two items, the parent and teacher interviews in combination with the multiple stimulus preference assessment add some validity to the item selected as this participant's circumscribed interest. Overall it appears that the three-step process of (a) independent confirmation of CI via parent and teacher interviews, (b) multiple stimulus preference assessments, and (c) choice conditions was an effective and systematic method to identify the participants' CI. Prior researchers who examined either the antecedent- (Adams, 1998) or consequence-based (Charlop et al., 1990; Charlop-Christy & Haymes, 1996) uses of CI did not validate caregiver's or teacher's hypotheses as to the tangible item identified that purportedly functioned as the participant's CI. In addition, the three participants engaged in higher percentages of social interactions during the CI in comparison to the LP sessions. In fact for all participants, percentage of time spent socially interacting in the LP sessions decreased to 0%. The use of CI to increase participant social behavior is consistent with the findings of prior studies (Baker, 2000; Baker et al., 1998). Finally, data show that targeted children initiated to peers sooner during the CI sessions.

Individuals with ASD appear to be motivated to pursue their CI, either through the accumulation of facts, or by engaging others in one-sided conversations around those interests (Attwood, 1998). Such highly preferred, child-initiated interests may provide a starting place to tap into potential aspects of social-motivation. Although researchers have been able to teach children with ASD discrete social behaviors (e.g., to initiate a conversation) tapping into higher aspects of social-cognition (i.e., theory of mind) have proven more difficult (Chinn & Optiz, 2000; Ozonoff & Miller, 1995). The current study provides preliminary evidence that the embedded use of CI could serve as ''motivational'' antecedent variables to evoke target children's peer-related social interactions. Although the experimenter found the presence of the participants' CI to be functionally-related to increases in their social behavior, a number of limitations were implicit in the study's methodology, and to some extent, affect its outcomes and generality of the findings. First, as with most single subject studies, the small sample size limits the external validity of this study although it greatly contributes to its internal validity (Kazdin, 1982). Second, study participants had verbal language and some appropriate social behavior prior to the study although they were rarely displaying that behavior, as demonstrated by the pre-experimental data collected in their regular classrooms; yet, it is possible that the child must already have social skills for CI to produce social-motivational effects. Third, a systematic analysis of the effects of CI in more naturalistic contexts to determine if the observed effects would generalize to less controlled situations was not conducted. Fourth, the AT sessions were brief in their duration (5 min each), especially in comparison to more naturally occurring social interactions, and this may have influenced the study's findings. Fifth, the choice condition had to be modified for one participant because he engaged in perserverative choice-making behavior. One explanation for this finding is executive dysfunction, which has been implicated in the perserverative behavior of individuals with autism (Turner, 1997). Within the context of the current study, McIlvane and Dube's (2003) stimulus control topography (SCT) coherence theory also may help to explain such perserverative choice-making behavior and provide insight into generalization effects.

McIlvane and Dube (2003) postulated that stimulus control occurs when there is a high degree of concordance between the environmental contingencies arranged by the experimenter to bring the participant's behavior under stimulus control and the actual stimulus properties that come to control that behavior. Because a single stimulus contains multiple properties (e.g., size, shape, color), and any one of those properties may come to control the participant's behavior, concordance may not always occur. In such situations, it becomes imperative for the experimenter to determine which feature of the stimulus, if any, is controlling the participant's behavior. In regards to Jason, it was difficult to determine which stimulus properties of the choice condition controlled his choice-making behavior. For example, it is possible that any of the following stimulus features, or others, came to control his behavior: (a) experimenter verbal prompt to ''make a choice'', (b) tape on the floor dividing the area into two equal halves, and/or (c) simultaneous presentation of two tangible items. In regards to generalization, the authors state a number of conditions that must be present in the participant's environment for generalization to occur (see McIlvane & Dube, 2003, for a complete discussion). For example, stimuli in the generalization environment cannot occasion competing behavior(s) (i.e., any behavior other than targeted behavior) at the same frequency as the stimuli controlling targeted behavior. In essence, the occurrence of targeted behavior may become incompatible with the occurrence of competing behavior, making it less probable the participant will emit both behaviors at similar ratios. Thus, generalization of CI-based interventions may prove difficult if there are competing reinforcing stimuli in the classroom or home environment.

Future research must determine what specific stimulus conditions are necessary to facilitate generalization of social behavior from intervention to more naturalistic contexts. It is imperative to add to the limited evidence base Baker (2000) and Baker et al. (1998) established regarding the ability of CI-based interventions to facilitate generalization and/or maintenance of social behavior. We also must address how to help participants move beyond their CI, which may result in one-sided peer-related social interactions. One potential method is to pair the CI (i.e., a reinforcing stimulus) with neutral stimuli (e.g., other classroom toys or peers) and fade out the special interest as the neutral stimuli take on reinforcing properties of their own. In addition, the study's findings must be replicated with a larger and more heterogeneous group of individuals with ASD to identify the ASD subgroups most responsive to CI interventions. Lastly, future studies must examine both the quantity and quality of target children's social initiations and interactions because improvements in both are necessary to engage in ongoing, reciprocal social relationships with peers.

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