BRIEF REPORT

Brief Report: Measuring the Effectiveness of Teaching Social Thinking to Children with Asperger Syndrome (AS) and High Functioning Autism (HFA)

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Abstract This is the first report from a large multiple baseline single-subject design study of children with Autism Spectrum Disorders (ASD). This brief report examines effectiveness of teaching a social cognitive (Social Thinking) approach to six males with Asperger syndrome (AS) or High Functioning Autism (HFA). Data included are restricted to pre-post-treatment comparisons of verbal and non-verbal social behaviors. Structured treatment and semi-structured generalization sessions occurred over eight weeks. Results indicated significant changes from pre- to post- measures on both verbal/nonverbal "expected" and "unexpected" behaviors, significant increases in the subcategories of "expected verbal", "listening/thinking with eyes", and "initiations", and robust decreases in the subcategories of "unexpected-verbal" and "unexpected-nonverbal". Importance of social cognitive approaches for children AS and HFA is discussed.

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Introduction

Social difficulties in children with autism spectrum disorders (ASD) are well recognized and considered to be a defining characteristic of autism (Krasney et al. 2003; Ozonoff and Miller 1995; Marriage et al. 1995; Weiss and Harris 2001). Interventions for social deficits reported in the literature vary widely in scope and effectiveness. Treatment studies commonly report the use of discrete *skill*-based approaches to teaching social behaviors, especially for children with emerging language or limited language skills. For children with ASD who possess more complex language, for instance, Asperger syndrome (AS) or High Functioning Autism (HFA), social *cognitive* tasks, such as interpreting verbal/nonverbal actions/intentions, understanding social reciprocity, and adjusting verbal/nonverbal behavior according to social cues, prove troublesome (Koning and Magill-Evans 2001; Ozonoff and Miller 1995; Tsatsanis et al. 2004; Weiss and Harris 2001). Social *skill* training, which involves the explicit teaching and reinforcement of desired discrete social skills, has been and continues to be a key feature of intervention for children with autism since the mid-1960's (Strain and Hoyson 2000). The literature is clear in stating that social *skills* can be taught, however, efficacy reviews do not boast "large-scale improvements" or evidence of generalization (Barry et al. 2003, p. 687; Bellini et al. 2007; Krasney et al. 2003; Williams et al. 2006). Why do traditional social interventions not lead to enduring social proficiency? It may be that the majority of treatment approaches fail to address the

cognitive aspect of social interactions and relatively few studies have attempted to understand the efficacy of treatments based on social *cognition.*

While traditional social skill interventions are heavily rooted in the principles of behaviorism, advances in cognitive and social sciences have sparked a shift in attention to social cognition. Howard and Renfrow (2003) attribute the growth of social cognition to "a reaction to the earlier dominance of behaviorism, a reductionist model that does not capture the nuances of a wide range of social behavior" (p. 260). The importance of social cognition in human relationships and development is widely recognized across disciplines. Psychologists and social psychologists refer to social cognition as the process whereby "people make sense of other people and themselves" (Fiske and Taylor 1991, p. 260) or as the acquisition and processing of social knowledge, as well as understanding how social forces contour social knowledge. Recent advancements in the field of cognitive neuroscience have allowed researchers to make important connections between brain development and its relationship to social cognition during adolescence. Blakemore and Choudhury (2006) reported the influence of the prefrontal cortex in self-awareness, perspective taking, and executive functioning based on a review of recent brain imaging studies. They postulate that the proliferation of synapses and pruning that naturally occurs in adolescence, combined with hormonal changes are likely to influence social cognitive growth.

> During this time [adolescence], what is perceived as important in the social world around us also changes and leaves its imprint on the pruning process. Accumulating new social experiences, for example, when entering a new school, may influence the development of social cognitive processes (p. 302).

Thus, social cognition is the complicated process whereby individuals acquire, understand and use social knowledge to quickly and accurately respond to verbal and nonverbal social information. It is this process that forms the foundation for successful human communication and it is the hallmark deficit in social knowledge in individuals with Asperger syndrome/ High Functioning Autism (AS/HFA).

One aspect of social knowledge is understanding that others have thoughts, beliefs, intentions, desires, and feelings that are distinct from ones own, also known as Theory of Mind or perspective taking (Baron-Cohen et al. 1985). A person's ability to modulate effortlessly to another's perspective is instantaneous and emerges in typically developing children early and without celebration. However for children with AS or HFA, the process is painstaking and confusing.

Few treatment studies have attempted to address social cognitive deficits in individuals with autism. However, an early study by Ozonoff and Miller (1995) used social cognition as the framework to examine the effectiveness of training theory of mind in five boys with autism. This study included a non-treatment group and used modules to train conversational, interactional, and perspective-taking skills. Outcome measures were based on performance on theory of mind tasks and parent/teacher report via the Social Skills Rating Scale (SSRS) (Gresham and Elliot 1990). Results indicated gains in perspective-taking skills in treatment subjects compared to controls. However, parents and teachers reported a lack of generalization to other settings. The investigators, while acknowledging gains on post-treatment theory of mind tasks, questioned whether the treatment simply taught subjects how to solve false belief tasks. Further, they suggested that the approach used in this study may have simply provided subjects the ability to "hack out rules and strategies to infer the mental states of others" (p. 429), rather than teaching the underlying application of those skills during real life social situations. These data seem to suggest that the predictive relationship between theory of mind and social behavior may be unidirectional (i.e., possessing good social skills implies theory of mind understanding; however, theory of mind understanding does not necessarily indicate appropriate social skills). It is also possible that false beliefs tasks, once called the "litmus test" of theory of mind by Baron-Cohen, are not a valid means of measuring dynamic social change. Perhaps there is too large a discrepancy between learning to perform a task and gleaning the overarching concept and applying it in a practical, everyday setting.

Recently, studies examining the social cognitive deficits in individuals with ASD have begun to emerge in the literature. Gevers et al. (2006) studied the effectiveness of a theory of mind intervention within a social cognitive framework in 18 children with pervasive developmental disorder (PDD). Post-treatment results indicated improvement on measures of theory of mind, interpersonal relationships, play/leisure, and social skills. Tse et al. (2007) reported the effects of a 12-week group-based social training for children with AS and HFA (AS/HFA). Each week, the instructors focused on a different skill. Skills targeted included: awareness and expression of feelings, making eye-contact, recognition of non-verbal communication, politeness, introducing oneself to others, starting a conversation, maintaining a conversation, ending a conversation, making small talk, negotiating with others, responding to teasing and bullying, hygiene, dining etiquette, and dating etiquette. Outcomes were based on parent/subject questionnaires; however, results indicated significant changes on measures of social competence and problem solving from pre- to post-treatment.

Williams et al. (2006) provide a thorough review of fourteen studies spanning two decades (1984–2004) that

examined social skills training administered in a group format to school-age children with ASD. Of the fourteen studies examined by Williams et al., three did not include quantitative data. Three of the remaining eleven studies found no statistically significant improvement in any areas by any method following treatment. Of the eight remaining studies, only two studies indicated significant change on all measures taken. The most frequent parent report quantitative outcome measure employed across studies was the SSRS.

While the majority of social intervention studies have utilized either questionnaires or post-treatment tasks designed to measure intervention targets (e.g., theory of mind tasks), few studies have utilized actual observation of social behavior in real-time social exchanges. Barry et al. (2003), examined the effectiveness of an outpatient clinic-based social skills group intervention on four children with HFA ranging in age from six to nine. Rule-based instruction was provided through social scripts in a clinical setting and then targeted behaviors (i.e., greeting, play, and conversation) were measured during interactions with trained typically developing peers following the lessons. Measures used to determine effectiveness included the SSRS parent rating form, the Loneliness Scale, the Social Support Scale for Children, observation of play sessions with typical peers, and a weekly telephone interview with the participants' parents to assess generalization abilities. Observation data indicated significant improvement in greeting and play skills and trend for improvement in conversational skills. Comparison of pre and post-treatment SSRS scores revealed no significant change in the areas assessed by the instrument. Comparison of pre and post-instruction Loneliness Scale measurements suggested that the participants experienced a clinically significant albeit not statistically significant decrease in loneliness. Analyses of the Social Support Scale pre- and post-treatment indicated that a perceived increase in social support was felt from classmates but not from parents, teachers, or friends. Bauminger (2002) also found encouraging results when examining the effects of a cognitive behavioral intervention program designed to facilitate social cognition and social interaction among peers in fifteen children with HFA. Intervention consisted of instruction in the nature of friends and friendship, emotion identification, and thirteen types of social initiations. The participants parents, classroom teachers, and peers administered treatment. Results indicated improvement in all three areas targeted, suggesting that increasing social cognitive competencies can result in improved social functioning. Bauminger (2006) utilized the same treatment model as Bauminger (2002), but added blind observers and unbiased teacher reports to the experiment design. The study yielded similar results to Bauminger (2002).

Krasny and colleagues (2003) reviewed the existing literature for group social skill interventions in children with ASD. They reviewed five key studies conducted over the past 25 years and found ongoing issues in group social skills research. First, most studies did not use outcome measures that were "objective and performance-based," nor did they examine generalization to differing environments. Second, they reported a relative absence of social curricula designed for the autism population. Finally, the authors made suggestions for the "essential ingredients" for a model social skill curriculum, including (a) make the abstract concrete, (b) visual structure and predictable routines, (c) activities that provide support for language abilities, (d) interactions that require focus on peers as well as self-awareness, and (e) generalization.

Solomon et al. (2004) addressed some of the concerns expressed by Krasny et al., by investigating the effects of a social enhancement curriculum in 8–12 year old boys with autism when compared to a control group. The curriculum focused on emotion recognition, theory of mind, and executive functioning/problem solving in subjects. Parents were simultaneously involved in a weekly psychosocial training component. Results indicated statistically significant changes in all three targeted areas as well as improved ratings of depression in subjects and mothers. Outcome measures were similar to others reported in the social skills intervention literature (i.e., clinical measures rather than observations of targets in social exchanges).

One current approach that addresses the "essential ingredients" for social interventions (Krasney et al. 2003), as well as considers the underlying social cognitive knowledge required for the expression of related social skills is referred to as *Social Thinking* (Winner 2000, 2002). *Social Thinking* is grounded in theory related to social cognition and promotes teaching the "why" behind socialization without implicitly targeting discrete social skills. Further, the well-documented deficits in executive functioning in ASD (Ozonoff et al. 1991; Twachtman-Cullen 2000) are addressed within the *Social Thinking* paradigm. Two years of pilot data (2003–2005) based on 55 children with AS/HFA from the University of Arizona's communication clinics have shown increases in the use of positive social skills, as well as an increase in the understanding of the "why" underlying social skills. While this pilot data is encouraging and constitutes an acceptable foundational level of evidence within the communication sciences (ASHA 2004), no controlled study examining such an approach has been reported in the literature. This study is part of a larger project examining the effectiveness and generalizability of a social cognitive approach—*Social Thinking*—in children diagnosed with AS or HFA.

Methods

Participants

Six children with a current diagnosis of either HFA or AS were recruited through the University of Arizona (UA) Grunewald-Blitz Clinic (GBC) for Children with Communication Disorders and the Tucson Alliance for Autism. Children were included in the study based on the following conditions: (a) Met the diagnostic criteria for either Asperger Disorder or HFA based on criteria from the Diagnostic and Statistical Manual of Mental Disorders (DSM IV) criteria (American Psychiatric Association 1994) and/or met criteria based on independent evaluations by a trained professional using the Autism Diagnostic Observation Schedule-ADOS (Lord et al. 2000) in conjunction with the Autism Diagnostic Interview-Revised-ADI-R (Lord et al. 1994); (b) aged 9–11 years of age; (c) Verbal IQ within the average range (85–115); (d) Hearing within normal limits; (e) No prior or current enrollment in a social intervention program within or outside the school setting. Table 1 shows the characteristics of the six subject enrolled in the study.

All subjects were males and two of six attended school in general education classes without additional academic or social support. One child received additional services for reading/written language, but no social intervention. One child attended a private school and received outside speech/language therapy for specific language skills and two children were considered home-schooled due to enrollment in a computer-based "virtual academy," but received no additional academic or social support. No subjects were taking medications during the study, however Subject 4's parents reported the use of herbal remedies in the past for attention issues.

Setting(s)

There were two different settings included in this study-one for treatment and a separate site for baseline and generalization measures. Setting #1 was the University of Arizona Grunewald-Blitz Clinic (GBC) and served as the BASELINE as well as the GENERALIZATION site. This setting was a large room with two round tables, a sink, microwave, kitchen area, television and computer. Setting #2 was located in a different part of the city at the Tucson Alliance for Autism. Setting #2 served as the TREATMENT site for *Social Thinking* intervention. This setting was a large clinic room with one square table, white board and bulletin board. Two sites were included in this study to compare generalization from a structured clinic-based site (Setting #2 -Treatment) to a non-structured, non-treatment environment (Setting #1-Generalization).

Design

This study is one piece of a larger, multiple baseline treatment study that examined the effectiveness of a Social Thinking approach in six adolescents with AS/HFA across behaviors and environments. In this brief report, only pre and post-treatment measures are reported.

Measures

Three verbal and two nonverbal behaviors were selected as dependent measures. Of these five, three were considered "Expected" and two were coined "Unexpected" (Winner 2002). Definitions are provided in Table 2.

Behaviors were measured by counting the actual frequency of occurrence of each behavior (i.e., verbal or nonverbal) during a social exchange.

Social Exchange was defined as any verbal or nonverbal behavior produced by one partner toward another partner within the context of a mutual or shared activity (Kennedy et al. 1997).

Table 1 Individual subject diagnostic and intervention characteristics

Subject (age)	Dx	Diagnostic instrument(s)	Diagnosing professional	Academic intervention	Social intervention
1. (9:6)	AS	ADOS/ADI	Psychologist and psychiatrist*	None	None
2. (10:3)	AS	DSM-IV	Psychiatrist	None	None
3. (10:2)	AS	ADOS/ADI	Psychologist and psychiatrist*	None	None
4. (11:1)	HFA	DSM-IV	Psychiatrist	Speech/language	None
5. (11:2)	AS	ADOS/ADI	Psychologist and Psychiatrist*	None	None
6. (9:4)	HFA	ADOS/ADI	Psychologist and psychiatrist*	Reading/written Lang.	None

* ADOS/ADI conducted by licensed psychologist and psychiatrist as part of an interdisciplinary diagnostic team

Table 2 Definitions for verbal/nonverbal behaviors

Expected-verbal		Any instance of verbal output that involved a comment or question in response to another person in a social exchange OR as an attempt to sustain a topic or initiate a social exchange.
	Verbal	(1) *On-topic remark* was defined as any remark that added to the current topic by adding a topic-related comment.
		(2) *One-word comments* were defined as single word responses that served as an attempt to sustain the interaction (e.g., yeah, uh-huh, okay, yep, oh).
	Initiations	*Initiations* were defined as any comment or question that served to engage another individual or group in a novel social exchange. Questions/comments in this category included those based on a) visible cues (i.e., t-shirt, book, toy); b) on prior knowledge about the conversational partner (e.g., hey…you were the guy with the gameboy right?) or c) personal interest comment or question (e.g., "Have you ever been to Sierra Vista?").
Expected-nonverbal		Any instance of a nonverbal behavior that is *clearly* an attempt to sustain a social exchange.
	Listening with eyes	*Listening with eyes* was defined as looking in the direction of the speaker's head OR looking at an object or person that was the topic of the social exchange.
Unexpected-verbal		Any instance of verbal output that involved negative comments about people, places, and/or things that were easily interpreted by any listener as offensive, rude, odd or inappropriate to the environment.
	Verbal	(1) *"Rude" remarks* were defined as comments that could be readily identified offensive to a peer group or could result in hurt feelings. Examples included: Name-calling (e.g., baby, stupid-head, etc), negative remarks directed to someone in the group (e.g., you're ugly, you suck) or about possession and or interests of others (e.g., If you like spiderman, you're stupid).
		(2) *Perseverative topics* were defined as any topic that occurred at least 5 times within the session and were related to a subject's personal interest. Any instances of repetitive topics were then confirmed by parent report.
		(3) *Off-topic Comments* were defined as any comment that was in no way related to the topic of the exchange or attempted to shift the topic without providing a shift or bridge to the new topic.
		(4) *Talking to Self/Mirror* was defined as any verbalizations that occurred without a clear listener, including talking to self in the one-way mirror.
		(5) *Yelling/Screeching/Screaming* during a social exchange or interaction.
Unexpected-Nonverbal		Any instance of nonverbal behavior that involved atypical movements (of body or objects) that *distracted* from the social exchange or activity.
	Nonverbal	(1) *Arm movement* was defined as raising one or both arms above the level of the shoulders and exhibiting movement that was clearly atypical, including hand mannerisms (exception: stretching or raising hand to answer question).
		(2) *Head movement* was defined as a 90 degree turn from the reference point (i.e., speaker) during a social exchange (exception: dropping something on the floor and looking to retrieve).
		(3) *Leg movement* was defined as raising one or both legs to or above the level of the hips or moving legs in a manner that is clearly atypical.
		(4) *Sound effects/noises* were defined as any sound/noise that was unrelated to the topic at hand and did not contain a clear linguistic purpose.
		(5) *Atypical object use* was defined as using an object in a manner that was not intended AND resulted in a distraction during a social exchange.
		(6) *Misc. Nonverbal* included the following nonverbal behaviors:
		a. Closing eyes during a social exchange.
		b. Looking at self in the mirror—without verbal.
		c. Putting head down on the table during a social exchange.
		d. Repetitive touching/poking/tapping others without the clear intention of gaining attention.

Procedures

Baseline Measures

Two baseline measures were collected for all subjects in Setting #1 (University of Arizona). The first half of the 90-min baseline measures included a non-structured group gathering time (i.e., adults moved in and out of the room as children arrived) followed by a semi-structured activity (e.g., art activity). One adult presented materials and written instructions to the subjects and then moved from the group area. No direct social instruction occurred during baseline. The second half of the session consisted of dinner/dessert/games. The adult supplied the activity items,

but did not provide positive/negative feedback on behaviors. The only exceptions occurred when one subject attempted to harm another child (session 2) or destroy property (sessions 1–2).

Treatment Measures

Group treatment sessions began at Setting #2 (Tucson Alliance for Autism) after baseline and lasted for eight consecutive weeks. Each session was 60 min in length. Treatment was based on addressing social cognitive deficits through a series of lessons designed to promote *Social Thinking* (Winner 2002). In this approach, the "why" underlying the use of social skills was addressed. Unlike previous studies reported in the literature, this approach does not use reinforcement to increase desired social behaviors, nor does it use tangible consequences or punishment to decrease less desirable behaviors. Instead, children were taught to understand that others had "thoughts" separate from their own and that "social" is based on understanding and regulating others' thoughts via their own individual behaviors. It is important to note that this approach differs from a strictly behavioral model of teaching and is therefore a unique addition to the "social skills" literature. Further, this approach follows the recommendations by Krasney et al. (2003) in that Social Thinking is based on: making abstract concepts concrete, using visual structure support language abilities, focusing on self/peer awareness and highlighting activities to promote generalization to "real-world" interactions. A brief description of lessons is listed in Appendix and a full curriculum is available for review from the author of the curriculum.

The format of each treatment session included the following components: (a) *Gathering* (3–5 min of open talk time); (b) *Group lesson* (Specific social cognitive strategies/*Social Thinking* Lessons); (c) *Practice/Unstructured time* (i.e., snack and "open topic" discussions among group members). Therapists provided verbal/visual feedback during the practice/unstructured time to reinforce the lesson. Attendance rate for treatment sessions was 100%. This is considered to be an excellent rate for groups conducted in outpatient settings (Schroeder and Gordon 2002).

Generalization Measures

Generalization probes occurred four times over the course of treatment (8 weeks) and were measured at the University of Arizona (Setting #1). Five of the six subjects participated in all four generalization sessions. The sixth child missed one generalization session. Generalization sessions were conducted in the same manner as the baseline measures. The first half of the 90 min generalization sessions were comprised of a non-structured group gathering time (i.e., adults moved in and out of the room as children arrived) followed by a semi-structured activity (e.g., art activity). No direct social instruction was given during generalization sessions. The second half of the session consisted of dinner/dessert/games. Adults supplied the appropriate items, but did not provide positive/negative feedback on behaviors.

Data Reduction/Analysis

All sessions were videotaped for later transcription and data analysis. Two 15-min segments per subject were selected from the pre-treatment (1st baseline) and post-treatment (final generalization) sessions for further analysis. The two 15-min segments (total of 30 min of data) represented the same activities during the sessions for all subjects, whether pre- or post-treatment:

(1) First 15 min immediately following the written instructions for the art activity (semi-structured),
(2) First 15 min of the dinner and games period (unstructured).

Each 15-min segment was transcribed and coded using the definitions from Table 2. Unintelligible utterances were excluded as well as questions/comments directed to adults across the room. Each occurrence of "expected" or "unexpected" verbal or nonverbal behavior was coded into only one category and a frequency count obtained for each of the behaviors for each subject for each session. To calculate inter-rater agreement for simple coding of "expected" and "unexpected" behaviors as well as coding into categories, two raters independently coded one-third of all samples. The only stipulation was that all subjects were represented in the reliability samples. Raters were blind to the phase from which segments were selected (e.g., pre versus post). Raters were independently given a transcript of each reliability sample and asked to initially rate the behavior as "expected" or "unexpected." Agreement was calculated on a response-by-response basis (i.e., agreements divided by disagreements × 100). Inter-rater agreement for the simple distinction of "expected" versus "unexpected" was 100%. The raters then independently coded each act into one category from the definitions listed in Table 2. Reliability for coding each of the subcategories varied: Expected-verbal (84%), Listening/thinking with eyes (95%), Initiation (80%), Unexpected-Verbal (83%) and Unexpected-Nonverbal (98%). All disagreements were discussed until consensus on coding was achieved.

Table 3 Frequency of verbal/nonverbal behaviors for pre- and post-group data

	Pre	Post
Expected total		
Subject 1	14	88
Subject 2	42	85
Subject 3	32	56
Subject 4	20	71
Subject 5	54	123
Subject 6	12	60
	*$p <= .03$	
Unexpected total		
Subject 1	92	9
Subject 2	96	68
Subject 3	24	9
Subject 4	10	3
Subject 5	74	17
Subject 6	4	0
	*$p <= .03$	
Expected categories		
Expected-verbal	*$p <= .03$	
Listening with eyes	*$p <= .03$	
Initiations	*$p <= .03$	
Unexpected categories		
Unexpected-verbal	$p <= .125$	
Unexpected-nonverbal	$p <= .15$	

* Wilcoxon signed-rank

Results

The most salient finding from this brief study is that significant changes occurred from pre- to post-training measures on both *Expected ($p <= .03$)* and *Unexpected ($p <= .03$)* verbal and nonverbal behaviors (see Table 3). Additionally, significance was demonstrated within the *Expected* subcategories of *Expected Verbal ($p <= .03$)*, *Listening with Eyes ($p <= .03$)*, and *Initiations ($p <= .03$)*. Although shifts in *Unexpected* behaviors were significant for the group, sub-category data did not reveal significant findings: *Unexpected Verbal ($p <= .125$)* and *Unexpected Nonverbal ($p <= .15$)*.

Further, visual inspection of individual subject data show significant changes from pre- to post-treatment. All six subjects showed increases in all subcategories of *Expected* behaviors (See Fig. 1). Subjects 1, 5 and 6 exhibited the greatest increase in *Expected Verbal* behaviors, while Subjects 2, 3 and 4 showed moderate increases. Significant increases were evident across all subjects in *Initiations* and *Listening/Thinking with Eyes*.

Data from *Unexpected* behaviors showed that Subjects 1–3, 5 decreased *Unexpected-Verbal* behaviors from

pre- to post- status, however, Subjects 4 and 6 had no instances of Unexpected Verbal behaviors during baseline. Of note, Subjects 4 and 6 were the only two subjects receiving outside language intervention and the only two with a diagnosis of HFA (see Fig. 2). While Subjects 1–4 and 6 showed a decrease in *Unexpected*-Nonverbal behaviors, Subject 5 exhibited an increase during the final session.

Discussion

The need for evidence defining the effectiveness of social interventions for children with AS/HFA has reached a point of urgency. The most recent report on the prevalence of autism is 1 in 150 live births (CDC 2007) and most practitioners and educators are faced with meeting the social needs of children with ASD on a daily basis. This brief report showed pre- and post- treatment data related to a larger intervention study that has analyses currently underway. The purpose of this study was to examine the effectiveness of a social cognitive intervention (*Social Thinking*) in 9–11 year old boys with AS and HFA. Group data showed significant gains on dependent measures from baseline to the final generalization session. Further, robust changes were documented for the group within sub-categories of *Expected*. Changes occurred within the subcategories of *Unexpected*, but were not significantly different for the group as a whole. This study adds to the small pool of clinic-based studies examining the efficacy of social interventions based on social cognition for children with AS and HFA.

This study is unique in that it differs from previous social cognitive intervention studies where outcome measures were based on performance on theory of mind tasks (Gevers et al. 2006; Ozonoff and Rogers 1991) or performance on other related clinic-based measures (Solomon et al. 2004; Tse et al. 2007). Instead, outcomes were measured in "real time" interactions in a second non-treatment environment which allowed for the observation of not only the occurrence of social behaviors, but generalization as well. The increase in socially "desirable" behaviors over time did not occur because subjects' social behaviors were reinforced via a behavioral paradigm within the treatment sessions. Rather, subjects may have increased "positive" or expected social behaviors as a result of learning about their own social behaviors and the impact on others' thoughts about them.

The distinction between teaching Social *skills* and Social *Thinking* is subtle, but important. As the shift to developing social interventions for individuals with AS/HFA occurs, the difference between teaching "skills" versus "thinking about the why behind using the skills" becomes more

Fig. 1 Pre- and post-measures of categories of EXPECTED behaviors (expected-verbal, initiation, listening/thinking with eyes) by subject
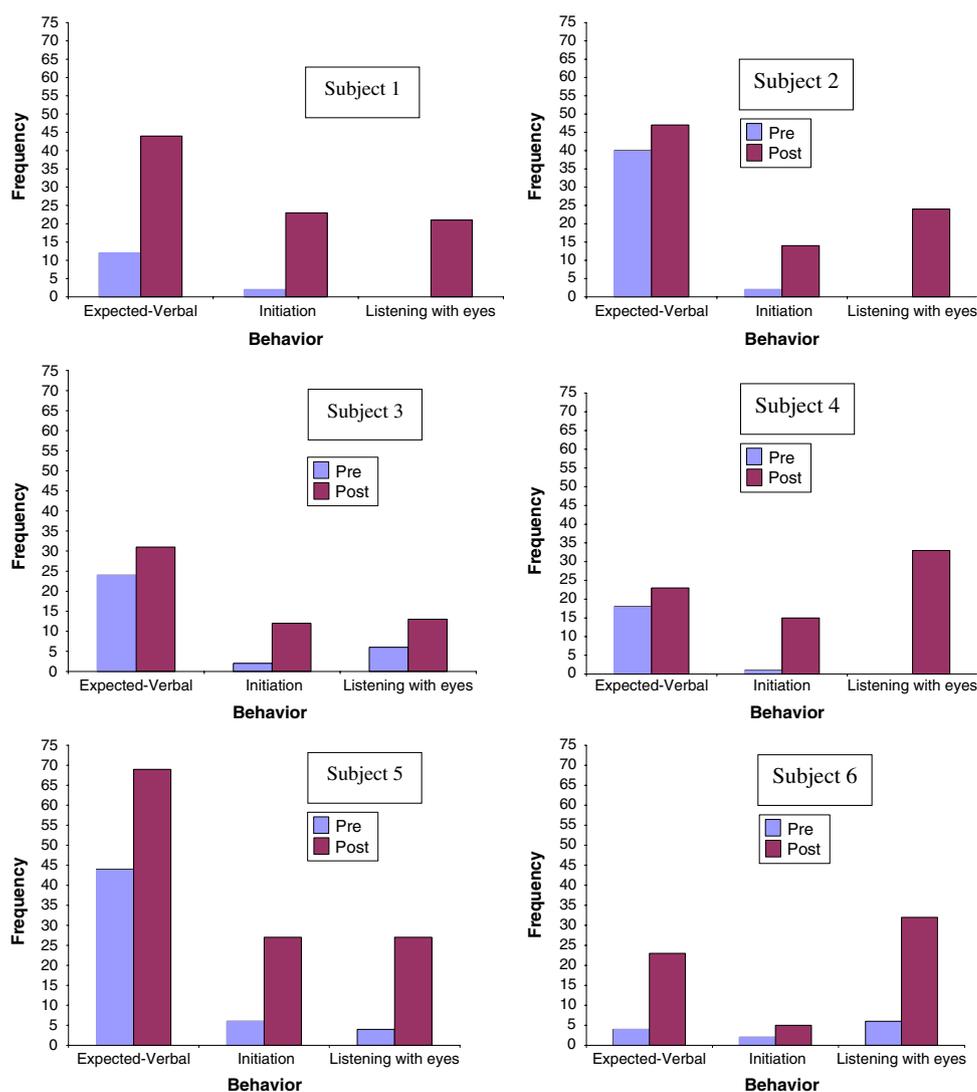

relevant. Social skills are traditionally introduced through behavioral techniques focusing on discrete skills. For instance, increasing eye contact is regularly reported in the skill-based literature. While the technique for teaching this skill varies across studies, the assumption is that the understands why and what s/he should be looking at to sustain the social connection. In a skill-based approach, a child might be asked to "look" at the conversational partner's eyes. The skill then requires shaping and reinforcement in clinical and natural environments. Unfortunately, the "rule" for looking at a person's eyes, the object they are holding, or the shift in gaze to a referent and back are difficult to teach in a discrete manner. The subtle nuances of eye contact are overwhelming when dissected to their most basic levels. However, *Social Thinking* teaches children to "think with your eyes," "listen with your eyes," and that "looking equals thinking." Thus, thinking with eyes helps students with ASD

explore others' intentions and consider more accurately peoples' emotions in real time interactions with peers. This insight can then foster the emergence of social growth. While in this example, the outcome of increased eye contact may be the same for both approaches; *Social Thinking* teaches the underlying social cognitive process of producing the outwardly apparent social skill. It is important to note that this intervention, although based on a manualized curriculum from Winner (2002, 2005) is not a "cookbook" approach. The curriculum is designed to promote core principles (e.g., steps of communication, steps of perspective-taking, etc.) through social cognitive activities, but the basic principles must remain dynamic according to the interactions within each treatment session.

An ongoing debate in the autism literature revolves around distinguishing AS from HFA and other PDDs. While the results of this debate may have significant ramifications for some treatments, this debate is not

Fig. 2 Pre- and post-measures of categories of UNEXPECTED behaviors (unexpected-verbal, unexpected-nonverbal) by subject
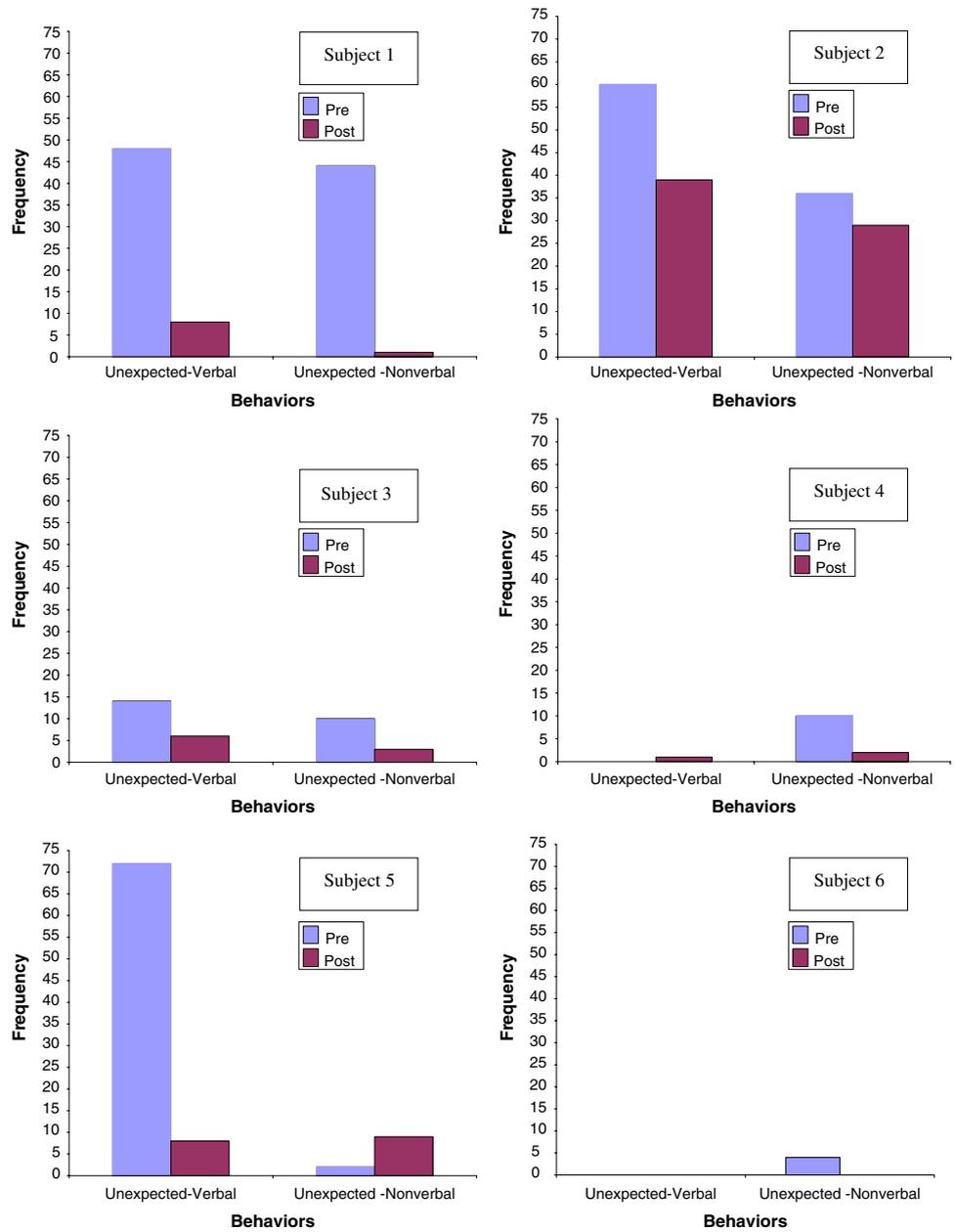
relevant for the purposes of this study. Rather, the distinction that should be considered when using a *Social Thinking* approach is whether the child has a level of language and cognition that will allow understanding of the "why" behind social behaviors. It appears that this metacognitive approach may be more relevant for children with AS/HFA than a skill-based approach given that it provides students information to gain insight and social understanding to help them understand how to apply related social skills. This is not to say that behavioral principles are not relevant in social interventions for children with autism. Rather, this study shows that, for this specific sub-population of autism, a social cognitive approach may be more effective.

Limitations

The first limitation of this study is the small sample size ($n = 6$), however statistical significance for the group was still evident. Second, greater treatment effects may have been limited by the short amount of time dedicated to treatment. Another significant limitation in this brief report is lack of control condition due to pre- and post-treatment data. This

limitation was considered and is addressed in the larger single subject multiple baseline design. Additional limitations in this study that are addressed in the larger study are generalization of behaviors across environments, parent perception of change, subject perception of change, long-term generalization and measures of perspective-taking change. Finally, subjects were familiar with the adults across all sessions. While this may have positively influenced the decrease in "unexpected" behaviors (a pattern that did not occur in all subjects), the increase in "expected" behaviors toward *peers* would not have been predicted simply by adult familiarity.

Conclusions

Despite some limitations in the current study, pre- and post-treatment comparisons showed significance. Initial impressions from these data suggest that teaching *Social Thinking* to children with AS/HFA may be an effective approach for increasing positive social behaviors and decreasing less desirable social behaviors within this specific sub-population. This model is a shift from traditional social skill interventions in that *Social Thinking* promotes understanding of "why" related social skills are relevant in social exchanges. This study raises valuable issues for future research. First, researchers should further investigate which treatments might be the most effective for differing levels of autism and cognitive and language profiles. Second, this study could easily be replicated using a design similar to Solomon et al., where subjects on a waiting list served as the control population. More importantly, single subject design studies are needed to accurately compare each child to his or her own baseline over time to measure changes in understanding and use of related social skills in real-time social interactions.

Appendix

All lessons were based on "thinking about what others are thinking about you" (Winner 2002, 2005). Also, the regulation of verbal and nonverbal behaviors can keep others' thinking the way you want them to think about you.

General Lesson Descriptions

Looking = Thinking: What One is Looking at Represents what that Person is Thinking About

During this lesson the participants were taught that what one is looking at represents what that person is thinking about. For example, if you are talking with someone and he is looking at you, it signifies that he is thinking about you or what you are saying. Participants were taught that when they look at something other than the speaker, such as a picture on the wall, they are sending the message that they are thinking about the picture and not the speaker or their words. In other words, "looking = thinking" or "eyes have thinking."

Expected vs. Unexpected: Verbal and Nonverbal Actions have Thought Consequences

In this lesson, the participants were taught that verbal and nonverbal actions have consequences in terms of how other people think about you and that "expected" actions can generate good thoughts and "unexpected" actions can generate weird thoughts. Participants were also taught that they can change others' thoughts by changing their own actions.

Whole Body Listening: Bodies and Eyes are a Part of Listening and Conversation

Participants were taught that listening occurs with more than just ears. People also listen with their eyes, shoulders, hands, feet, and body, etc. Whole body listening reflects keeping all parts of one's body "in the group." This relates back to the kinds of thoughts others have about you and is connected to expected versus unexpected nonverbal behaviors.

Social Files: Brains Make Social Memories that Give Us a Strategy for Initiations

Participants were taught that social files are "brain files" for people to learn and remember things about each other. Storing information about others occurs in the form of social memories. "Social files" provide a framework for initiations. This lesson taught participants to be social "spies" and to observe others in their environment. Social files were related to looking = thinking, expected and unexpected, and whole body listening. Lessons were always related to the kinds of thoughts others have about you.

Knowledge and Opinions: What to Keep in & Let Out: Filtering Verbal Behavior (Unexpected Stays in Your Head & Expected Comes Out) Influences the Thoughts that Others Have About You

Participants were taught that certain types of knowledge/opinions should stay in one's head and certain types of knowledge/opinions can come out. Participants were taught

that knowledge should stay in if it is off topic, a "data dump" of facts, corrects someone. Participants were taught that opinions are always right but should not always be stated aloud. The lesson was then related to the thoughts that others have about one another and how to change or maintain others' thoughts by filtering one's own verbal comments.

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