

School-based social skills training for preschool-age children with autism spectrum disorder

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Keith C Radley¹, Jeanine Hanglein² and Marisa Arak³

Abstract

Individuals with autism spectrum disorder display impairments in social interactions and communication that appear at early ages and result in short- and long-term negative outcomes. As such, there is a need for effective social skills training programs for young children with autism spectrum disorder—particularly interventions capable of being delivered in educational settings. The study evaluated the effects of the Superheroes Social Skills program on accurate demonstration of social skills in young children with autism spectrum disorder. Two preschool-age children with autism spectrum disorder participated in a weekly social skills intervention. A multiple probe design across skills was used to determine the effects of the intervention. Both participants demonstrated substantial improvements in skill accuracy. Social skills checklists also indicated improvements in social functioning over baseline levels.

Keywords

preschool, social skills training

Impaired social communication represents a core deficit of autism spectrum disorder (ASD; Carter et al., 2005). Research indicates that social deficits in children with ASD are apparent from the early months of life (Sigman et al., 2004). Social impairments become more salient between 12 months and 3 years of age, evidenced by the findings that most parents of children with ASD begin to express concerns by 18 months (Howlin and Moore, 1997). During this time, toddlers with ASD show reduced attention to social stimuli (e.g. Klin et al., 2002), demonstrate substantial impairments in social orienting (Dawson et al., 1998), utilize poor eye contact (Gilberg et al., 1990), and display increased levels of isolation from peers (Dahlgren and Gillberg, 1989; McConnell, 2002). As children with ASD enter preschool, they are often educated in inclusive classrooms (Boyle et al., 2011; Odom, 2000; Yeargin-Allsopp et al., 2003). However, social deficits of children with ASD impede typical interaction with peers (Bellini et al., 2007) and limit benefits of placement inclusive settings (Bellini and Akullian, 2007; Koegel et al., 2012).

As additional supports are likely necessary to support discrete social skill use and general social functioning of children with ASD (Hansen et al., 2014), social skills training interventions are often implemented (Goin-Kochel et al., 2007). Although social skills training is a frequently

utilized intervention, reviews and meta-analyses indicate that research in social skills training is often limited methodologically and that results are often mixed (e.g. Bellini et al., 2007; Hansen et al., 2014; Rao et al., 2007; White et al., 2006). In order to improve the state of social skills research and better identify practices that may be beneficial to children with ASD, researchers have recommended that future studies assess social skills via multiple informants (White et al., 2006), adequately describe participants (e.g. IQ, adaptive functioning; Hansen et al., 2014; White et al., 2006), assess skill generalization and maintenance (Bellini et al., 2007; Rao et al., 2007; White et al., 2006), evaluate manualized training curricula (Rao et al., 2007; White et al., 2006), and evaluate the effects of training using randomized controlled trials (Rao et al., 2007; White et al., 2006).

Recent studies have addressed several of the recommendations of previous reviews and meta-analyses, aiding

¹University of Southern Mississippi, USA

²Fairleigh Dickinson University, USA

³Queens College, USA

Corresponding author:

Keith C Radley, Department of Psychology, University of Southern Mississippi, 118 College Drive # 5025, Hattiesburg, MS 39406-001, USA.
Email: keith.radley@usm.edu

in the identification of strategies that may be effective for training social skills in young children with ASD. For example, Murdock et al. (2013) found video modeling to result in improved and maintained discrete skill use in young children with ASD with diverse levels of cognitive functioning and language abilities. Similarly, Leaf et al. (2010) found behavioral skills training to result in maintained and generalized discrete skill accuracy in 4- to 6-year-olds with ASD. Although studies such as these have addressed some of the recommendations of previous reviews and meta-analyses (Bellini et al., 2007; Hansen et al., 2014; Rao et al., 2007; White et al., 2006), the recommendation for increased evaluation of manualized interventions has been less thoroughly addressed by recent researchers—perhaps due to the fact that relatively few manualized interventions are available (Lord et al., 2005).

Although the development and evaluation of manualized interventions facilitate replicability and assessment of fidelity of social skills training interventions (e.g. White et al., 2006), manualization may also have important practical implications—particularly in school settings. Recent research indicates that as few as 5% of teachers report using empirically supported practices for children with ASD (Morrier et al., 2011). Dingfelder and Mandell (2011) suggest that many evidence-based practices for children with ASD, such as video modeling and behavioral skills training, may not readily be adopted in school settings as they represent intervention strategies without program materials or clear procedural guidelines. Manualization of social skills interventions is likely to address barriers to implementation associated with limited training in evidence-based interventions of school personnel, perceived and actual feasibility, and limited resources (e.g. Bellini and McConnell, 2010; Kasari and Smith, 2013).

Superheroes Social Skills

The Superheroes Social Skills program (Jenson et al., 2011) is an example of a manualized social skills intervention for children with ASD. The intervention comprises 18 lessons targeting distinct social skills. Similar to other manualized social skills programs (e.g. Laugeson and Frankel, 2010; Winner, 2005), the Superheroes Social Skills program incorporates didactic instruction in target skills, behavioral rehearsal, and provision of performance feedback—practices previously found to promote acquisition of target social skills (e.g. Leaf et al., 2010; Murdock et al., 2013). The Superheroes Social Skills program differs from other manualized social skill curricula in that it incorporates video modeling, found to substantially improve social performance in children with ASD (Wang et al., 2011), and, instead of relying on facilitator-provided instruction in target skills, utilizes animated superhero characters who provide instruction in target skills to increase learner interest (Milne et al., 2011). The program

is also unique in that typically developing peers are included in intervention sessions, allowing children with ASD to practice target social skills and contact social reinforcement from peers who may serve as discriminative stimuli for skill use in generalized settings. Superheroes Social Skills also aims to overcome poor generalization effects of school-based social skills training (e.g. Bellini et al., 2007) by providing participants with multiple exemplars of target skill use during video models and behavioral rehearsal and by engaging functional mediators of behavior through training participants to self-monitor use of skills (e.g. Stokes and Osnes, 1989).

Block et al. (2015) investigated the effects of Superheroes Social Skills when implemented in an elementary school setting with four children with ASD. Participants were aged 8 and 9 years, with an average IQ score of 92.2 (range=76–123). A total of 12 skills from the curriculum were presented over an 11-week period, with twice-weekly intervention facilitated by a researcher. Following implementation of intervention, slight increases in social initiations of participants were observed during recess periods. More substantial improvements were observed in social responses of participants. Additionally, parent and teacher ratings of social functioning indicated improved social skill use following conclusion of the intervention.

In a similar study, Radley et al. (2014a) evaluated the effect of participation in Superheroes Social Skills on social engagement behavior of four elementary-age participants during recess periods. Participants ranged in age from 8 to 10 years and had an average IQ score of 103.3 (range=61–130). Participants attended a weekly social skills group facilitated by a researcher. Results indicated substantial increases in the duration of social engagement during recess periods for all four participants following introduction of intervention. Similar to Block et al. (2015), checklists completed by parents at the conclusion of the study indicated improvements in social functioning in non-training settings. Sociometric data were also collected to determine the effect of participation on social connectedness of participants. Although sociometric data were only collected for two of the four participants, increased social connectedness was observed for these participants—suggesting that participants may have generalized skill use to non-participant classmates. Radley et al. (2015) conducted a systematic replication of Radley et al. (2014a), including five elementary-age students in a school-based, researcher-facilitated, evaluation of the curriculum. Participants were aged 5–11 years. All participants demonstrated increases in social engagement with peers during recess periods following implementation of intervention, with improvements maintained at a 5-week follow-up. Sociometric data suggested increased connectedness with peers at both post-intervention and 5-week follow-up.

In addition to examination of the effects of the Superheroes Social Skills curriculum on social behaviors

of children with ASD during recess periods, research has also evaluated the effect of participation in the intervention on accurate demonstration of target social skills (Radley et al., 2014b). Four elementary-age children with ASD aged between 10 and 14 years, one of whom was identified as having a mild intellectual disability, were trained in four skills from the Superheroes Social Skills program in a clinic setting. Skills taught were selected based on parent-identified social skills deficits. Introduction of the intervention resulted in enhanced skill accuracy when participants were provided with previously rehearsed cues for target social skill use by known researchers. In addition, participants demonstrated generalized improvements when provided novel cues for social skill use by unknown researchers in a new setting. Unlike Radley et al. (2015), no follow-up data were collected, and it is unknown whether improved accuracy was maintained over time. Similar to school-based evaluations of the program (Radley et al., 2014a, 2015), parent-completed checklists of social functioning revealed improvements in parental assessment of social skill use.

In the only evaluation of the program with preschool-age children, Radley and colleagues (in press) evaluated the effects of the program on three 4- and 5-year-old children with ASD with no reported cognitive deficits. Participants attended a 5-week intervention, with results indicating improved skill accuracy and parental perception of social functioning. Probes of skill accuracy in non-training settings also demonstrated improvements in skill accuracy. It is, however, important to note that mastery of target skills was achieved more slowly than in studies including elementary-age participants (e.g. Radley et al., 2014b). Data collected during a maintenance phase revealed improved accuracy in comparison to baseline, but reduced in comparison to intervention phase data. No follow-up data were collected to assess for long-term changes in skill accuracy.

Purpose of the study

Given the importance of early intervention (e.g. Webb et al., 2014), and the need for supports for children with ASD to maximally benefit from placement in inclusive settings (Bellini and Akullian, 2007; Koegel et al., 2012), there is a clear need for social skills interventions for young children with ASD. Although several strategies have been identified as effective in promoting social skill use of preschool-age children with ASD (e.g. Koegel et al., 2014; Murdock et al., 2013), findings have been limited by methodological factors such as poor characterization of samples, lack of data from multiple informants (Hansen et al., 2014; Rao et al., 2007; White et al., 2006), and lack of follow-up data (Rao et al., 2007). Additionally, research has primarily investigated specific intervention strategies over manualized interventions (Rao et al., 2007; White et al., 2006), slowing the research to practice transition (Dingfelder and

Mandell, 2011). Although initial investigations of the Superheroes Social Skills program suggest the utility of the manualized intervention, participants have primarily been elementary-aged children with ASD who attended intervention groups facilitated by researchers. As the only study of the program with young children was conducted in a clinic setting and was facilitated by researchers, it is unknown whether similar results would be observed under other settings when facilitated by the intended end users of the program (e.g. psychologists, teachers). Additionally, research evaluating the Superheroes Social Skills program has yet to address recommendations for evaluations of the maintenance of improvements in discrete skill use (e.g. Rao et al., 2007). Given these limitations, this study sought to provide a preliminary evaluation of the utility of the intervention in promoting accurate social skill use and maintenance of skills in preschool-age children with ASD. In addition, this study extends the previous literature through evaluation of effects of participation in the program when facilitated by school personnel, as well as through assessment of skill accuracy following termination of all intervention procedures. The following questions were generated to guide the investigation:

1. Is there evidence of a functional relation between implementation of the Superheroes Social Skills program by school personnel and accurate social skill demonstration of preschool-age children with ASD?
2. Is there evidence of maintained improvements in accuracy of target social skills at a 6-week follow-up?
3. Do teachers and parents describe participants' social functioning as improving following inclusion in the Superheroes Social Skills intervention?

Method

Participants

Prior to recruitment of participants, the study received Institutional Review Board approval. Participants included in this study were recruited from a preschool in the Northeastern United States that offered programming for both children with ASD and typically developing peers. Both children with ASD and typically developing peers were recruited as participants. Inclusionary criteria for participants with ASD included an educational classification of a Preschooler with a Disability and a diagnosis of ASD and no concurrent school-based intervention targeting social functioning. Additionally, participants were required to have the ability to attend to brief videos, as reported by teachers. Inclusionary criteria were shared with teachers, who nominated two potential participants who were reported to have difficulty initiating with peers, sustaining interactions, and

who primarily engaged in solitary play. A records' review was performed to verify educational classification and diagnosis of ASD.

Following identification of participants with ASD, two typically developing peers were also recruited from the inclusive classrooms of potential participants with ASD for inclusion in the study. Inclusion criterion for peers was demonstration of appropriate social skills within the classroom, based on teacher report. No other inclusionary criteria were mandated for typically developing peers nor were typically developing peers matched to participants with ASD in any way (e.g. similar interests, established relationships). The inclusion criterion was shared with teachers and two 4-year-old females were nominated for inclusion. Following identification of potential participants, consent and assent forms were sent home with potential participants with ASD and typically developing peers. Consent and assent forms were returned for all participants initially nominated for inclusion prior to collection of baseline data. Both participants with ASD and typically developing peers were familiar with the group facilitator prior to commencement of this study due to the group facilitator previously providing classwide social and behavioral interventions in the classrooms of the participants.

Participants with ASD included Clay and Jack. Clay, a 4-year, 5-month-old male, had received an educational classification of a Preschooler with a Disability from a school multidisciplinary team. Clay received a diagnosis of Pervasive Developmental Disorder—Not Otherwise Specified from a licensed psychologist at the age of 2 years 6 months using criteria from the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text revision; American Psychiatric Association, 2000). Jack, a 4-year, 3-month-old male, had received an educational classification of a Preschooler with a Disability from a school multidisciplinary team. Jack received a diagnosis of ASD from a licensed psychologist at the age of 3 years 7 months, using criteria from the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; American Psychiatric Association, 2013). Participant evaluation data are presented in Table 1.

Setting

Group social skills training (i.e. one group facilitator providing simultaneous instruction to all group participants) and probes of skill accuracy took place in a school-based office that was approximately 10 m × 10 m. The office contained a table and four chairs, and a computer upon which videos from the Superheroes Social Skills program were shown.

Materials

Materials utilized in this study included Superheroes Social Skills DVDs containing videos of animated superheroes providing instruction in target social skills and

Table 1. Participant evaluation data.

	Clay	Jack
WPPSI-III Full Scale IQ Score	82	76
Vineland—composite	70	71
Vineland—communication	76	74
Vineland—daily living	67	69
Vineland—socialization	70	74
Vineland—motor skills	82	82

WPPSI-III: Wechsler Preschool and Primary Scale of Intelligence—3rd ed. (Wechsler, 2002); SD: standard deviation. WPPSI-III and Vineland Adaptive Behavior Scale (Sparrow et al., 1984) scores are interpreted as $M = 100$, $SD = 15$.

accompanying video models for each target skill presented. Videos were displayed on a desktop computer with a 21.5-in monitor. Self-monitoring cards and social narrative comics from the program were also utilized as described in the intervention manual (Jenson et al., 2011). Various toys were utilized during behavioral rehearsal and probes of skill accuracy (i.e. Cariboo, toy cars, rug with road for toy cars, puppets, doll house, and mini bowling game). Finally, a data collection guide, which identified cues to be delivered at the beginning of probes and steps for the target skills, was utilized during probes of skill accuracy to ensure that probes were delivered and step accuracy was recorded consistently across phases.

Measures

Probes of skill accuracy. The primary dependent variable of this study was accurate demonstration of target social skills by participants with ASD. The group facilitator provided cues for target social skill use to each participant with ASD to begin each probe of skill accuracy skill. Cues utilized to assess the Introducing Self, Get Ready, Participate, and Body Basics skills were “Introduce yourself to (name),” “Get ready,” “Go play with (name),” and “Ask (name) if you can play,” respectively. Cues remained consistent and were delivered throughout each phase of the study. Using task analyses and accompanying latency or duration parameters developed for each target skill (Table 2), skill steps correctly demonstrated were recorded by the group facilitator. Next, the percentage of steps correctly demonstrated was calculated by dividing the number of steps accurately demonstrated by the total number of possible steps during the probe (i.e. four steps for Introducing Self, six steps for Get Ready, four steps for Participate, and five steps for Body Basics). The percentage of steps correctly demonstrated per probe was then graphed, with each data point represented one probe or opportunity to demonstrate the target skill.

With the exception of the initial baseline session and the final intervention session for the Introducing Self skill, three probes of skill accuracy were administered per skill during each session in accordance with the multiple probe

Table 2. Task analyses of target social skills.

Introducing Self	Get Ready	Participate	Body Basics
1. Demonstrate close physical proximity to the interaction partner or activity (within 1 m)	1. Orient head and shoulders toward the speaker	1. Demonstrate close physical proximity to interaction partner (within 1 m)	1. Face the person with head and shoulders oriented toward conversation partner
2. Orient head and shoulders toward the interaction partner within 3 s of approach	2. Initiate the Get Ready response within 5 s of request	2. Initiate and sustain eye contact with activity partner (3 s)	2. Make eye contact within 5 s and sustain for a minimum of 3 s
3. State name (e.g. My name is ...)	3. Put feet on floor, with soles of feet flat against floor	3. Wait for turn without skipping others or interrupting turn taking progression	3. Use an appropriate voice with a volume appropriate for setting
4. State personal like (e.g. I like ...)	4. Put hands flat against knees	4. Join in without disrupting the progression of activity using an activity appropriate response	4. Use the right expression by having facial expressions match conversation
	5. Make eye contact within 3 s of beginning the Get Ready response		5. Relax, evidenced by relaxed shoulders, even paced speech, normal breathing rate, and not playing with objects
	6. Maintaining the Get Ready position for a minimum of 3 s		

design. During these two sessions, one additional probe of skill accuracy was administered for the Introducing Self skill to better determine data stability. Up to two maintenance probes were delivered per skill per session during maintenance, and a total of three probes per skill were delivered during one follow-up session. The group facilitator allowed a minimum of 30 s between probes.

Social functioning. Prior to intervention, social skills to be targeted were identified using a parent- and teacher-completed Autism Social Skills Profile (ASSP; Bellini and Hopf, 2007). Following collection of follow-up data, the ASSP was readministered to parents and teachers of participants with ASD to assess for changes in ratings of social functioning. The ASSP was developed to address limited sensitivity to small changes in behavior of other social skills rating scales (Bellini and Hopf, 2007) and has previously demonstrated the ability to detect changes in social skill use associated with intervention (e.g. Block et al., 2015; Boyd and Ward, 2013; Radley et al., 2014b). Completion of the ASSP yields a Total Social Functioning score and subscale scores for Social Reciprocity, Detrimental Social Behaviors, and Participation/Avoidance. The 49 items included on the ASSP are rated on a 4-point Likert scale, ranging from never (1) to very often (4). Higher scores on the ASSP indicate more frequent occurrence of appropriate social behaviors. Technical evaluation of the ASSP has indicated high internal consistency ($\alpha=0.94$) and test-retest reliability ($\alpha=0.90$; Bellini and Hopf, 2007).

Experimental conditions

Design. A multiple probe design across skills with concurrent replication across participants (Cooper et al., 2007) was utilized to assess the efficacy of the program in promoting accurate demonstration of target social skills. Four experimental phases were included in the study: baseline, intervention, maintenance, and follow-up. All target skills were initially probed in baseline, at which point intervention was introduced for the first target skill dependent upon stability and trend of baseline data. Intervention and probing in the first target skill then commenced until a minimum of three consecutive probes of 100% skill accuracy were demonstrated by both participants with ASD. In other words, participants were yoked such that a new skill could not be introduced to one participant, while the other participant received instruction in a different target skill. Following demonstration of mastery of the first target skill, untrained skills were again probed in baseline, and intervention was introduced for the second skill dependent upon stability and trend. Phase changes and subsequent implementation of intervention for yet untrained trained target skills proceeded in this manner until intervention had been presented for all four target social skills.

Baseline. Prior to collection of baseline, parents and teachers of participants with ASD completed the ASSP. Using results of the ASSP, social deficits shared by both participants with ASD were identified and matched to social skills lessons within Superheroes Social Skills.

Identified deficits corresponded with the following skills included in the Superheroes Social Skills program: (1) Introducing Self, (2) Get Ready, (3) Participate, and (4) Body Basics. Following identification of skills to be taught from the Superheroes Social Skills program, baseline probes of skill accuracy were administered. Probes were administered using the data collection guide. Each probe consisted of delivery of a cue for target skill use by the group facilitator (e.g. "Go play with Cameron"), with skill accuracy assessed using task analyses developed for each target skill. Five seconds were allowed for participants to initiate the target skill, or all skill steps were scored as incomplete. No performance feedback regarding skill accuracy was provided to participants during baseline probes; however, praise was provided for compliance with facilitator cues for target social skill use. Three baseline probes were administered during the initial baseline session, with up to one additional probe administered dependent upon data stability.

Intervention. Participants attended a 1-h social skills group each week over the course of approximately 11 weeks. Social skills groups were facilitated by a licensed school psychologist with a Master's degree in school psychology. The facilitator had 13 years of experience working with children with ASD, previously working as a teacher's assistant and an applied behavior analysis provider prior to becoming a licensed school psychologist. Prior to implementation of the intervention, the facilitator briefly reviewed lesson format and required materials (e.g. computer to show DVDs) with the primary investigator. A checklist was utilized to ensure all components of a lesson were trained, with procedural integrity being 100%. A graduate student in special education was present as a secondary observer. Lessons were presented in a group format, with all participants receiving simultaneous instruction in the same target skill.

Procedures for intervention adhered to the Superheroes Social Skills manual (Jenson et al., 2011), with each lesson following the same format regardless of skill being taught. Although the Superheroes Social Skills program was designed for elementary-age students, no modifications were made to adapt the program for the preschool-age children included in this study. At the beginning of each session, the two participants with ASD and the two typically developing peers were welcomed to the social skills group by the facilitator. Probes for social skills in baseline and maintenance phases were then conducted for participants with ASD. Following probes for skills in baseline and maintenance, the facilitator informed the group of the target social skill and provided a brief rationale for skill use. A video was then shown via DVD which depicted animated superheroes who described the skill to be targeted, reiterated the rationale for use of the skill, and provided four to six discrete steps for skill use. Following instruction

provided by the animated superheroes, participants viewed video models of unknown, similarly aged peers. Three video models of appropriate skill use were viewed for each target social skill.

The group facilitator then modeled examples and non-examples of the target skill. Following presentation of each model, the participants were asked to determine whether or not all skill steps had been demonstrated. If participants were unable to identify whether skill steps had been accurately demonstrated, the facilitator provided error correction. The facilitator then engaged the participants in behavioral rehearsal for the target skill. Each participant with ASD was paired with a typically developing peer and provided with three to five opportunities to demonstrate accurate social skill use. During behavioral rehearsal, the facilitator provided behavior-specific praise following accurate skill use and error correction following inaccurate skill demonstration. Following behavioral rehearsal, participants viewed an animated social narrative via DVD. The animated social narrative depicted the superhero characters reviewing steps to utilization of the target social skill.

Using the data collection guide, probes of the skill in intervention were then administered using procedures identical to baseline. However, the facilitator provided behavior-specific praise for accurate skill use and error correction for inaccurate skill use. Three probes were conducted for the skill in intervention, with up to one additional probe conducted dependent upon data stability. At the conclusion of the group, all participants were provided with a small tangible reward for participation in the group. Participants were then returned to their regular classroom activities.

Maintenance. Following demonstration of skill mastery, operationally defined as a minimum of three consecutive data points of 100% skill accuracy demonstrated by both participants with ASD, target social skills entered a maintenance phase to assess maintenance of improvements in social skill accuracy, while other skills were in intervention. Using the data collection guide, one to two maintenance phase probes were conducted per session, with probes collected immediately prior to facilitation of the social skills group. Procedures for maintenance phase probes were identical to baseline, with no praise or error correction provided to participants. Praise for compliance with probe procedures was provided. During maintenance probes, the group facilitator provided participants with a cue for skill use and recorded the steps correctly demonstrated, calculating a percentage of steps utilized. No maintenance data were collected for the last skill instructed, as intervention procedures were discontinued following demonstration of skill mastery of the last skill.

Follow-up. Follow-up probes of skill accuracy were collected 6 weeks following termination of intervention

procedures. Follow-up probes were identical to baseline, with no praise or error correction provided to participants. Praise for compliance with probe procedures was provided. Follow-up data were collected in one session, with three probes delivered for each target skill. After completion of follow-up probes of skill accuracy, the ASSP was readministered to parents and teachers of participants with ASD.

Interobserver agreement

Prior to collection of baseline data, the primary researcher trained the group facilitator and a secondary observer in data collection procedures. Training consisted of a review of task analyses of each of the target skills. Examples of target skills were then reviewed and the group facilitator and secondary observer practiced coding of behaviors. Practice in observation of skill accuracy was repeated until 90% interobserver agreement (IOA) was established.

A graduate student in special education functioned as a secondary observer in order to obtain IOA. During probes of skill accuracy, the secondary observer recorded skill accuracy independently and simultaneously with the group facilitator. IOA was collected during 100% of probes across all experimental phases. IOA was calculated using an interval-by-interval method (Cooper et al., 2007), in which the number of intervals of agreement are divided by the number of intervals of agreement plus the number of intervals of disagreement and multiplied by 100. IOA for both Clay and Jack was found to be 100%.

Treatment integrity

The extent to which the Superheroes Social Skills program was implemented with integrity was evaluated using an intervention-derived treatment integrity checklist (Appendix 1). The treatment integrity checklist was completed after 100% of intervention sessions, with the percentage of correctly implemented intervention components calculated for each session. Treatment integrity was found to be 100%. In addition, IOA for treatment integrity was collected during 100% of intervention sessions by the secondary observer and was found to be 100%.

Data analysis

The effect of the Superheroes Social Skills program on accurate demonstration of target social skills was primarily evaluated using visual analysis. Six features of data were evaluated: trend, level, variability, immediacy of effect, overlap between phases, and consistency of data across similar phases (Kratochwill et al., 2010). In addition, nonoverlap of all pairs (NAP; Parker and Vannest, 2009) was calculated to quantify degree of overlap between phases. NAP is calculated by comparing each individual data point collected during a given condition with each

data point collected during a comparison condition (e.g. baseline vs intervention). NAP is equal to the number of comparison pairs that do not overlap, divided by the total number of data point comparisons. The given value depicts the probability that a randomly selected data point from one phase will exceed a randomly selected data point from a comparison phase. Possible NAP scores range from 0.00 to 1.00. Scores between 0.92 and 1.00 indicate strong effects, scores between 0.66 and 0.92 indicate moderate effects, and scores between 0.00 and 0.65 indicate weak effects (Parker and Vannest, 2009). For this study, NAP scores were calculated across skills comparing baseline with intervention, baseline with maintenance, and baseline with follow-up.

Results

Accurate demonstration of target social skills

The primary dependent variable was accurate demonstration of target social skills following a cue for skill use provided by the group facilitator. Clay demonstrated low levels of accuracy for the Introducing Self skill, with moderate and variable levels of accuracy for Get Ready, Participate, and Body Basics skills (Figure 1). Upon implementation of the Superheroes Social Skills program, improving trends of skill accuracy were observed for all skills. Skill mastery, operationally defined as three consecutive probes of 100% skill accuracy, was obtained in two intervention sessions for the Participate and Body Basics skills and three intervention sessions for the Introducing Self and Get Ready skills. NAP calculations for the intervention phase indicated a strong effect for the Introducing Self skill, with moderate effects for the remaining skills (Table 3). During maintenance, skill accuracy was observed to be 100% for all skills. With the exception of one probe of Body Basics, 100% skill accuracy was observed during all probes at follow-up. All NAP calculations for maintenance and follow-up phases indicate strong intervention effects.

During baseline, Jack demonstrated low levels of skill accuracy for Introducing Self, moderate and variable levels of accuracy for Get Ready and Participate, and variable and decreasing levels of accuracy for Body Basics (Figure 2). Implementation of Superheroes Social Skills immediately resulted in increasing trends of skill accuracy for all skills. Skill mastery was observed in two sessions for the Participate skill, with Introducing Self, Get Ready, and Body Basics requiring three sessions. Calculation of NAP revealed a strong intervention effect for the Participate skill, with the effects for the remaining skills considered moderate (Table 3). During maintenance, 100% skill accuracy was observed during all probes. Follow-up probes revealed high levels of accuracy for Introducing Self, Participate, and Body Basics. Although skill mastery was not observed at follow-up for the Get Ready skill, level improvements over baseline were observed.

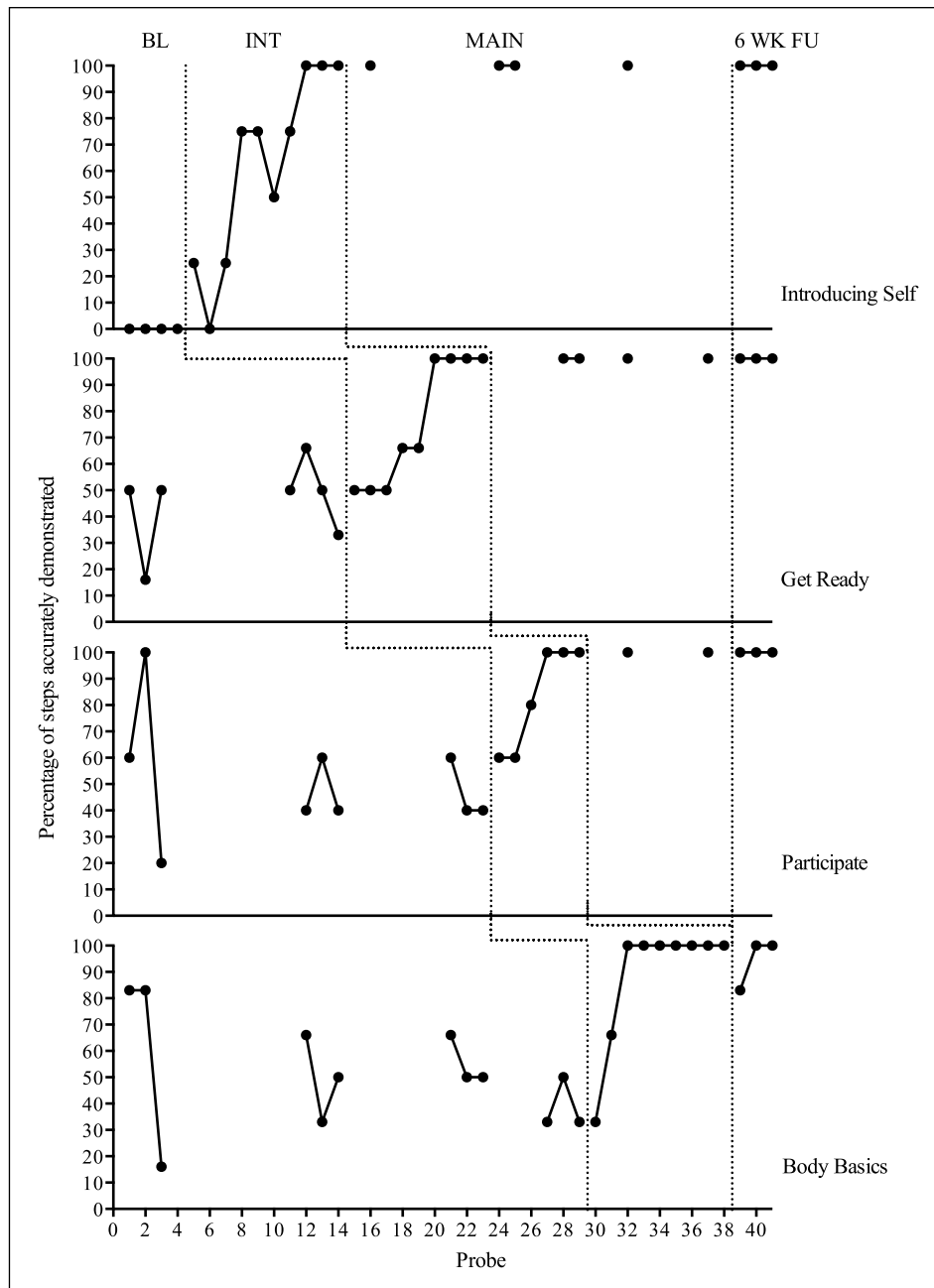


Figure 1. Accurate skill demonstration, Clay.

Table 3. Skill acquisition during intervention, maintenance, and follow-up.

	Clay			Jack		
	Intervention	Maintenance	Follow-up	Intervention	Maintenance	Follow-up
Introducing Self	0.95 (0.32–1.48)	1.00 (0.29–1.71)	1.00 (0.23–1.78)	0.87 (0.69–1.33)	1.00 (0.29–1.71)	1.00 (0.23–1.78)
Get Ready	0.84 (0.19–1.18)	1.00 (0.38–1.62)	1.00 (0.31–1.69)	0.81 (0.09–1.13)	1.00 (0.36–1.64)	1.00 (0.29–1.71)
Participate	0.86 (0.21–1.24)	0.94 (0.11–1.66)	0.94 (0.23–1.55)	0.99 (0.47–1.50)	1.00 (0.23–1.78)	1.00 (0.34–1.70)
Body Basics	0.88 (0.34–1.20)	N/A	0.97 (0.31–1.58)	0.88 (0.34–1.18)	N/A	0.96 (0.30–1.55)

Nonoverlap of all pairs (NAP) effect size scores below 0.66 are considered small, scores between 0.66 and 0.92 are considered moderate, and scores ranging from 0.92 to 1.00 are considered strong (Parker and Vannest, 2009). Strong effects in bold and 90% confidence intervals in parentheses.

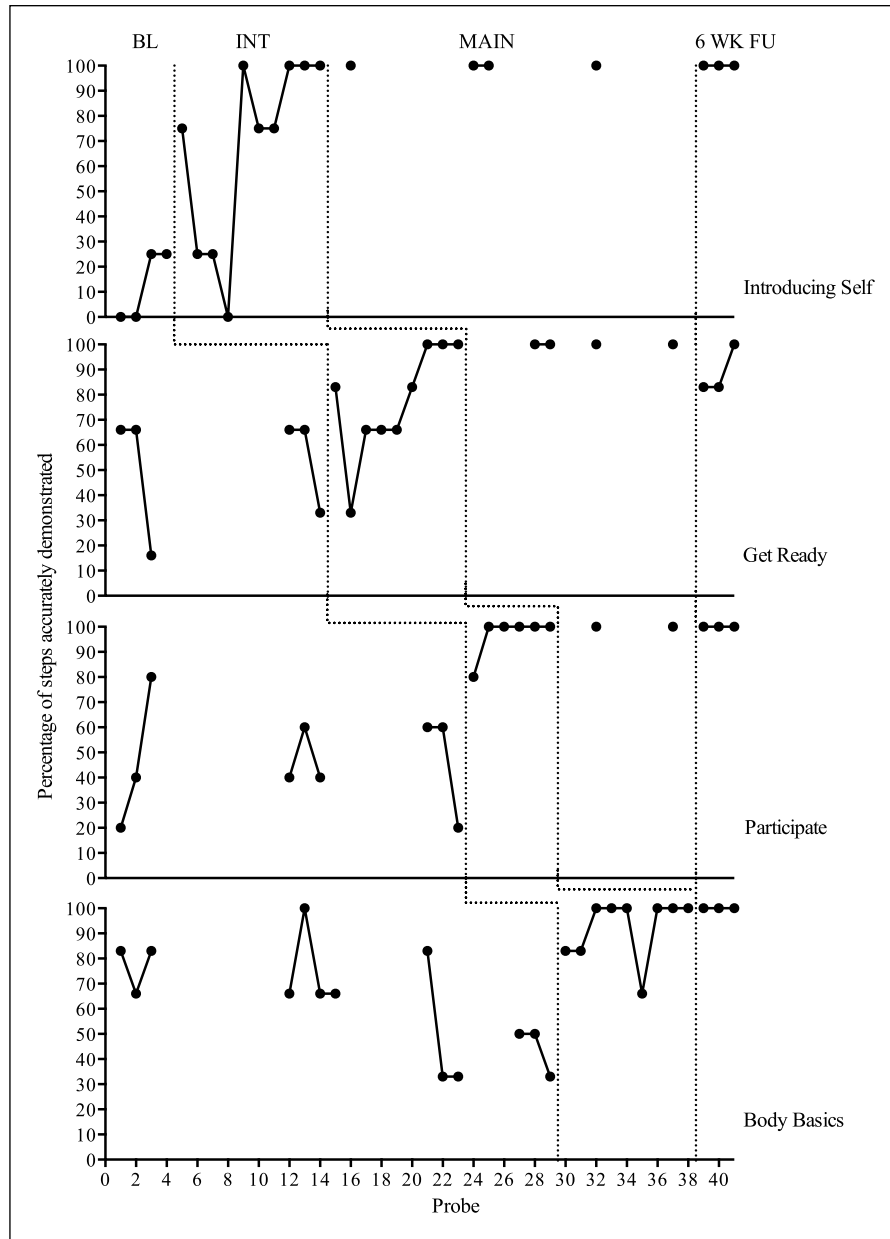


Figure 2. Accurate skill demonstration, Jack.

Social functioning

Parent and teacher perception of social functioning was assessed using the ASSP, administered during baseline and following the collection of follow-up probes. Pre- and post-intervention ASSP data are presented in Table 4. Substantial improvements in Total Social Functioning were noted by teachers and parents of both participants. In addition, substantial improvements were noted across raters for both participants on the Social Reciprocity subscale. Jack’s teacher reported no improvements on the Participation/Avoidance subscale, with Clay’s teacher reporting substantial improvement. Whereas a decrease in the Detrimental Social Behaviors score was noted on the

ASSP completed by Clay’s teacher, minimal improvement was noted by Jack’s teacher. Parents of Clay and Jack rated Participation/Avoidance and Detrimental Social Behaviors as demonstrating small improvements.

Discussion

This study represents a preliminary evaluation of the effect of lessons from the Superheroes Social Skills program on accurate demonstration and maintenance of target social skills by preschool-age children with ASD. Following implementation of intervention, participants demonstrated increasing trends of target skill accuracy. Mastery of each skill was demonstrated in two to three sessions for all skills

Table 4. Pre- and post-intervention ASSP scores.

Scale	Clay		Jack	
	Pre	Post	Pre	Post
Total Social Functioning—Parent	116	129	105	133
Total Social Functioning—Teacher	104	117	108	127
Social Reciprocity—Parent	49	56	40	56
Social Reciprocity—Teacher	41	51	39	57
Participation/Avoidance—Parent	23	25	25	28
Participation/Avoidance—Teacher	20	30	31	29
Detrimental Social Behaviors—Parent	33	35	33	37
Detrimental Social Behaviors—Teacher	30	27	29	30

ASSP: Autism Social Skills Profile.

taught, with NAP scores indicating moderate to strong intervention effects. Data collected during the intervention phase are consistent with previous evaluations of the Superheroes Social Skills program for young children with ASD (Radley et al., in press), with mastery being demonstrated less rapidly than in studies including elementary-age participants with ASD (e.g. Radley et al., 2014b). Taken together, results of Radley et al. (in press) and this study suggest that young children with ASD may require more extended exposure to intervention than elementary-age children with ASD in order to demonstrate skill mastery.

Maintenance data collected in this study differ from previous research evaluating the Superheroes Social Skills program for young children with ASD (Radley et al., in press). Whereas participants' skill accuracy decreased slightly during maintenance in Radley and colleagues, findings of this study indicate sustained mastery during maintenance. In addition, this study found accuracy to be maintained 6 weeks following discontinuation of intervention procedures—similar to findings of sustained improvements in social engagement following school-based intervention (Radley et al., 2015). Findings of sustained skill accuracy are particularly important, as follow-up is not often assessed (Rao et al., 2007), and studies that have collected follow-up often find poor effects (Bellini et al., 2007). Findings of maintained skill accuracy, which diverge from those of Radley and colleagues (in press), may potentially be attributed to the fact that the training group incorporated peers with whom participants with ASD interacted in non-training settings (e.g. classroom). School-based social skills may hold advantages over clinic-based training in the availability of peers who may be included in social skills training groups. Peers included in training may serve as discriminative stimuli for skill use in natural environments, provide additional opportunities to practice and receive reinforcement for skill use, and represent a sustainable and cost-effective strategy for training social skills. Constructing social skills groups comprising both participants with ASD and peers with whom participants with ASD may interact within non-training settings

may assist in overcoming the reduced efficacy intervention efficacy associated pull-out social skills groups conducted in non-naturalistic settings (e.g. Bellini et al., 2007).

Although no direct measure of skill generalization was collected in this study, it is important to note that both teachers and parents noted improvements in social functioning from baseline to intervention. Clinically significant improvements were noted across raters for both participants on the Total Social Functioning scale and the Social Reciprocity subscale, with smaller improvements on other subscales. Previous research has also noted substantial improvements on the Total Social Functioning scale and the Social Reciprocity subscale with minimal change on the Detrimental Behaviors scale, which includes items such as “Ends Conversations Abruptly,” “Exhibits Poor Timing with His/Her Social Initiations,” and “Changes the Topic of Conversation to Fit Self-Interests” (e.g. Radley et al., 2014a, 2015). These findings suggest that participation in the Superheroes Social Skills program may promote the use of social skills in non-training settings, but that the skills taught in this study do not sufficiently target these problem behaviors. Other skills from the Superheroes Social Skills curriculum, such as Turn Taking, Perspective Taking, Conversation Maintenance, and Problem Solving, may more effectively address problem behaviors than the skills included in this study. Additional research is necessary to determine whether other skills from the curriculum may be effective in addressing Detrimental Social Behaviors, or whether additional support may be necessary to reduce problem behaviors that may interfere with social skill use (e.g. addressing restricted/repetitive social behaviors through lag schedules of reinforcement, providing explicit instruction for discrete problem behaviors, and incorporating problem behaviors into non-examples of skill use modeled by facilitators).

Whereas previous studies have found participation in the Superheroes Social Skills program to result in improvements in skill accuracy when facilitated by a dedicated

researcher (e.g. Radley et al., 2014a, 2014b), this study found facilitation by school personnel to result in rapid acquisition of target social skills. Involving end users in research is an important component of bridging the research-to-practice gap (Dingfelder and Mandell, 2011), and although preliminary, findings of this study suggest that the intervention may be as effective when implemented by the intended end users as when implemented by research personnel. Although not included as a dependent variable of this study, it is also important to consider the fidelity with which the group facilitator implemented intervention procedures. Whereas previous studies have found procedures to be implemented with high integrity by research personnel, this study found the intervention to be implemented with fidelity by school personnel. The fidelity observed in this study further suggests that the intervention may be successfully implemented by the intended end users in applied settings.

Results of this study must be considered in light of several limitations. First, although high levels of intervention integrity were observed, only one facilitator was involved in intervention procedures. It is also important to note that the facilitator had completed training as a school psychologist and had received training in a scientist-practitioner model. As such, it may be that the facilitator had previous training and awareness of the importance of intervention integrity and evidence-based interventions. Additional research should examine the effects of the program when facilitated by other school personnel (e.g. special educators, school psychologists, and paraprofessionals), particularly when implemented by personnel with less formal training in monitoring and assessment of interventions. Second, observers in this study were aware of intervention condition and study hypotheses. Although high levels of IOA suggest that data may be considered reliable estimates participant behavior, future research should consider utilization of blinded observers. Similarly, the use of the group facilitator as the primary data collector may be considered a limitation. However, this limitation is lessened through collection of IOA during 100% of skill acquisition probes. Third, it is important to note that participants in this study were receiving concurrent school-based intervention (e.g. speech, occupational, and physical therapy; counseling), and concurrent services may have impacted results obtained in this study. As it would have been unethical and unfeasible to discontinue services required per individual education plans, it was not possible to evaluate the effects of the social skills intervention in isolation. However, the utilization of a multiple probe across skills design and the fact that immediate improvement in skill accuracy were observed for each skill following introduction of instruction suggests that improvements in skill accuracy are due to implementation of social skills training.

Fourth, a limited selection of lessons from the Superheroes Social Skills curriculum were presented as

part of this study. As such, it is unknown whether similar results would be obtained with other skills in the curriculum and whether skills presented later in the curriculum would be developmentally appropriate for preschool-age children with ASD. Future researchers should examine whether improvements in skill accuracy are observed following training in other skills included in the program. An additional limitation is that no data were collected on skill accuracy of typically developing peers. Future researchers may consider evaluating the effect of being a peer participant. Fifth, this study did not directly assess skill accuracy generalization across persons, settings, or cues for skill use. Although previous research suggests generalization across persons, settings, and cues for skill use following training (e.g. Radley and colleagues in press), it is unknown whether participants in this study would have demonstrated similar generalized improvements. The lack of assessment of generalization in this study is particularly limiting, as previous meta-analyses indicate that social skills may be successfully demonstrated in the training setting but fail to be observed in other settings (e.g. Bellini et al., 2007). Although parent- and teacher-completed checklists suggest improved social functioning in non-training settings, these data are limited in experimental control as they represent a simple pre- and post-intervention comparison, and future researchers should address these limitations through evaluation of skill accuracy and social functioning in diverse settings (e.g. home, community, and school). Future research evaluating the generalized effects of the intervention may also improve understanding of the social validity of the intervention.

Relatedly, in order to ensure a sufficient number of opportunities to observe each target response, as well as the fact that some responses were unlikely to be observed more than once without a cue to demonstrate the behavior (e.g. Introducing Self) or represented behaviors that typically followed an adult prompt (i.e. Get Ready), adult facilitators provided a cue to demonstrate each skill every time a skill was to be observed. As adult cues were determined to be necessary to provide adequate observation opportunities, systematic fading of cues over time was not conducted in this study. As such, participant demonstration of these target behaviors may have become dependent upon cues from adult facilitators. Future researchers should consider systematically fading adult cues for target skill use and observing the frequency with which target behaviors occur in unstructured settings.

No qualitative data regarding the quality of skill use demonstrated by participants, which represents an additional limitation. Future researchers may consider collecting qualitative data regarding skill fluency and overall social competence (e.g. Gresham et al., 2001). Finally, consideration must be made that the Superheroes Social Skills program is a multicomponent intervention. Although the simultaneous implementation of multiple strategies

(e.g. video models, behavioral rehearsal, and performance feedback) resulted in improved skill accuracy for both participants, it is unknown which of these strategies was most associated with behavior change. Future investigations may consider a component analysis of the intervention, allowing for determination of strategies essential to intervention success.

Conclusion

Early intervention is critical for children with ASD and allows for maximal benefit from placement in inclusive educational settings (e.g. Webb et al., 2014). Despite the need for early intervention, research in social skills training often fails to collect data from multiple informants, provide adequate characterization of participants, assess generalization and maintenance of social skills, examine the effect of manualized interventions, and utilize randomized controlled trials to evaluate intervention effectiveness (Bellini et al., 2007; Hansen et al., 2014; Rao et al., 2007; White et al., 2006). This study addresses many of these limitations, finding the Superheroes Social Skills program to result in high levels of skill accuracy during and following termination of intervention. Data collected from multiple informants (i.e. teachers and parents) also indicate improved social functioning. As this study did not assess generalization or fading of adult cues, the results of the study should be considered preliminary, and additional research is needed to address these limitations. However, the study provides important initial information regarding the potential utility of the program in meeting the need for manualized social skills programs for young children with ASD that may be implemented within school settings.

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Appendix I

Procedural integrity from for Superheroes Social Skills Program implementation

Skill: _____

Date: _____

Observer: _____

This form is used to assess the level of procedural integrity for each component of the Superheroes Social Skills program. Record if components were conducted as planned (Yes) or not conducted as planned (No) during each group instruction session; or if the day's session did not require a particular component (N/A).

Superheroes Social Skills program components	Yes	No	N/A
1. Check in: Have materials placed in front of the group, children are seated, brief review of prior session (where applicable)			
2. Review rules and purpose of session			
3. Introduce skill and explain rationale			
4. Watch corresponding Fast hands and Animation			
5. Instructor role plays both a positive and negative example of the skill			
6. Children watch Digital Comic			
7. Play social game			
8. Conduct probes of skills in baseline/intervention			
9. Explain homework			
10. Superhero of the day and tangible reinforcers			