

Supplemental Table 1. Evidence for the Effectiveness of Social Skills Interventions for People With ASD

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Bellini, Peters, Benner, & Hopf (2007)	Level I Meta-analysis 55 single-subject-design studies; total $N = 157$.	<i>Intervention</i> Interventions used in studies reviewed were not described in detail but included collateral skills, peer mediated, child specific, and comprehensive. <i>Control</i> Varied by study	The primary outcome measure used was PND for 2 different types of skills (depending on the study): collateral skills (play, JA, etc.) and social interaction skills (social initiations, social responses, etc.).	No significant differences were detected for intervention effects, maintenance, or generalization across the type of intervention, type of dependent variable, or type of participant.
Castorina & Negri (2011)	Level II 3 groups (social skills + sibling, social skills alone, wait-list control), nonrandomized $N = 21$ boys (age range = 8–12 yr). Social skills + sibling group, $n = 7$. Social-skills-alone group, $n = 8$. Wait-list control, $n = 6$.	<i>Intervention</i> 8 2-hr weekly sessions. Sessions were fully scripted by leaders and adapted from Spence (1995). Sessions focused on skills considered lacking in people with Asperger syndrome (i.e., eye contact, body language, tone of voice, facial expression). Social dilemmas were presented and explored through role-play, games, and modeling by leaders. Participants earned points each week for positive behaviors and had homework. Siblings received no training. <i>Control</i> Wait list	<ul style="list-style-type: none"> • Parent satisfaction survey • Child and Adolescent Social Perception measure (videotaped observation) • SSRS (parent/teacher report). 	<p>Parents whose children participated alone were more satisfied than parents whose children participated with a sibling (no significance reported).</p> <p>There was no evidence to suggest enhanced maintenance for the social skills + sibling group.</p> <p>Parents rated social skills higher at 3-mo follow-up than at pretest and posttest (even for control group; $p = .001$).</p> <p>No significant improvement was found in teacher-rated social skills.</p>
Chan et al. (2009)	Level I Systematic review 42 articles; total $N = 172$, ages 2–13 yr.	<i>Intervention</i> PMTs, which varied in design by study. Methods for training peers included verbal explanation; discussion using guided questioning; modeling; role-plays; and practice in combination with ongoing feedback providing correction, prompts, or redirection. <i>Control:</i> Varied by study	Varied by study	<p>The review stated that PMI is versatile and may have a positive effect upon children with ASD and/or PDD–NOS.</p> <p>The design of the included studies was not considered in detail, making it difficult to confirm the level of evidence.</p> <p>Authors did not report using percentages of PND or any consideration of significance of PND.</p>
Cotugno (2009)	Level II Two-group, nonrandomized pretest–posttest $N = 28$ (age range = 7–11 yr).	<i>Intervention</i> 60 min 1×/wk for 1 yr (30 total sessions). Peer-based group model that used cognitive-behavioral techniques and skill instruction. Based on cognitive developmental framework. Addressed social	<ul style="list-style-type: none"> • WMS (teacher report) • Massachusetts General Hospital YouthCare Social Competence/SCDS (parent report). 	<p>WMS teacher ratings significantly improved for both age groups ($p < .01$); 7- to 8-yr-olds had the greatest improvement in teacher-preferred ($p < .05$) and peer-preferred ($p < .05$) behavior, and 10- to 11-yr-olds had the most</p>

(Continued)

Supplemental Table 1. Evidence for the Effectiveness of Social Skills Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
	<p>$n = 18$ children with ASD who received intervention. Children were divided into smaller groups for treatment (7- to 8-yr-olds and 10- to 11-yr-olds).</p> <p>$n = 10$ matched typically developing children who did not receive the intervention.</p>	<p>competency needs and concerns of the children (stress-anxiety, JA, flexibility-transitions) and also specific stages that children with ASD go through as they evolve. High degree of predictability in sessions.</p> <p><i>Control</i> No treatment</p>		<p>improvement in school adjustment behavior ($p < .01$).</p> <p>Change on the SCDS was not analyzed statistically; the percentages of children showing little to no demonstration of positive adaptive behavior decreased from pretest to posttest but varied by group.</p>
de Bruin & Verheij (2012)	<p>Level III</p> <p>One-group pretest-posttest</p> <p>$N = 10$ children with PDD-NOS (7 boys, 3 girls; M age = 8.5 yr).</p>	<p><i>Intervention</i></p> <p>16 sessions over a period of ~6 mo; 14 treatment sessions (~1.5 hr each) and 2 follow-up sessions. Sessions were manualized and very systematic, e.g., (1) get to know each other, (2) show that you listen. 4 parent meetings also took place in which parents learned about SST in general and their child's progress.</p>	<ul style="list-style-type: none"> • CSBQ (parent report) • SPPC (child self-report). 	<p>CSBQ total ($p < .05$, $d = 0.50$) and Social Understanding subscale ($p = .01$, $d = 0.62$) scores were significantly lower at posttest than at pretest.</p> <p>SPPC Scholastic Competence subscale scores were significantly higher at posttest than at pretest ($p < .05$, $d = 0.62$), and Physical Appearance subscale scores were significantly lower at posttest than at pretest ($p < .05$, $d = 1.07$).</p> <p>These results were in the opposite direction of what would be expected, and the authors did not know why this happened (physical looks not addressed in SST).</p>
DeRosier, Swick, Davis, McMillen, & Matthews (2011)	<p>Level I</p> <p>RCT</p> <p>$N = 55$ children with high-functioning ASD (age range = 8–12 yr).</p> <p>S.S.GRIN-HFA group, $n = 27$.</p> <p>Control (traditional S.S.GRIN) group, $n = 28$.</p>	<p><i>Intervention</i></p> <p>Two different sessions run simultaneously.</p> <p>S.S.GRIN-HFA: 15 1-hr sessions 1x/wk; parents attended and participated in 4 sessions.</p> <p><i>Control (S.S.GRIN)</i>: 10 1-hr sessions 1x/wk; parents did not attend sessions but could correspond with leaders. Treatment integrity was monitored throughout.</p>	<ul style="list-style-type: none"> • Demographic questionnaire • SRS (parent report) • ALQ (parent report) • Social Dissatisfaction Questionnaire (child self-report) • Social Self-Efficacy Scale (parent and child self-report). 	<p>Separate MANOVAs run by report type (parent and child).</p> <p><i>Parent Report</i></p> <p>A significant main effect was found for intervention condition ($p < .05$).</p> <p>Univariate analyses approached significance for Social Self-efficacy ($p < .01$).</p> <p>Parents in intervention group reported improvements on both SRS and ALQ, and parents in the control group reported a decline on both SRS and ALQ; effect sizes ranged from moderate to large.</p> <p><i>Child Report</i></p> <p>No significant main effect was found for treatment condition.</p> <p>No significant effects were found for univariate analyses by area of functioning.</p>

(Continued)

Supplemental Table 1. Evidence for the Effectiveness of Social Skills Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Farr, Yuill, & Raffle (2010)	<p>Level II</p> <p>Two-group, nonrandomized (ASD vs. TD)</p> <p><i>N</i> = 12 children (age range = 7–11 yr) who were chronologically age matched with a 2-yr delay to account for developmental delay.</p> <p><i>n</i> = 6 boys with ASD (age range = 8–11 yr).</p> <p><i>n</i> = 6 TD children (1 girl, 5 boys; age range = 7–9 yr).</p>	<p><i>Intervention</i></p> <p>Children with ASD familiarized with Topobo for approximately 2 hr over 2 wk to offset familiarity with LEGO. Children were given a plan of a creature-model and asked to make it with Topobo or LEGO, then asked to make their creation move the length of a ruler, and then asked to make another creation of their own choosing and make up a little story about it.</p> <p><i>Control</i></p> <p>Typically developing children followed the same intervention protocol.</p>	<p>Video coding (total duration of play, descriptive analyses of play state sequences).</p>	<p><i>Social Interaction Analysis</i></p> <p>Children with ASD engaged in more parallel ($p < .05$) and less solitary ($p < .01$) play with Topobo than with LEGO.</p> <p>No significant differences were found in associative, cooperative, onlooker, disengagement, or repetitive behaviors.</p> <p>TD children engaged in more cooperative ($p < .05$), parallel ($p < .05$), and associative ($p < .05$) play and less solitary ($p < .05$) play with Topobo than with LEGO.</p> <p>No significant differences were found in onlooker, disengagement, or repetitive behavior.</p> <p><i>Play Sequence Analysis</i></p> <p>There was a bidirectional loop between solitary and associative play with both materials in both groups.</p> <p>A similar relationship between onlooker and disengagement behavior was found in the ASD group, but disengagement behavior only preceded onlooker behavior in TD group.</p> <p>The sequences were similar for the TD group regardless of material, but different in the ASD group according to material.</p> <p>Topobo provided more opportunities for children to move into interactive play states regardless of whether they had ASD or were TD.</p>
Flynn & Healy (2012)	<p>Level I</p> <p>Systematic review</p> <p>22 studies, most of which were single-subject design; ages varied from 3 to 20 yr.</p> <p>Databases searched included ERIC, SpringerLink, PubMed, SagePub, Wiley Online, and ScienceDirect. Inclusion</p>	<p><i>Intervention</i></p> <ul style="list-style-type: none"> • PMI • SSG • Script fading procedures • PRT • Video modeling (social skills and self-help skills separated) • Reinforcement-based procedures. <p><i>Control</i></p> <p>Varied by study</p>	<p>Outcomes varied by study but included social initiations, social responses, turn taking, play skills, and self-help skills (e.g., meal preparation, toilet training).</p>	<p><i>PMI</i>: All 4 studies demonstrated improved social skills, but 1 study showed only modest increases.</p> <p><i>SSG</i>: 2 of 3 studies had significant increases across all participants.</p> <p><i>PRT</i>: All 3 studies showed significant improvements in participants.</p>

(Continued)

Supplemental Table 1. Evidence for the Effectiveness of Social Skills Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Gantman, Kapp, Orenski, & Laugeson (2012)	<p>Level I</p> <p>RCT (pilot)</p> <p>$N = 17$ young adults with ASD (12 men, 5 women; age range = 18–23 yr) and their caregivers.</p> <p>$n = 10$ in treatment immediately.</p> <p>$n = 9$ received treatment after 14-wk waiting period.</p> <p>1 participant was dropped because of prohibitively severe behavioral problems.</p>	<p><i>Intervention</i></p> <p>14 weekly 90-min sessions in groups of 9–10. Young adults and caregivers attended concurrent groups. The purpose of the lessons was to provide instruction and practice for social skills related to building close relationships (e.g., conversation skills, electronic communication, appropriate use of humor). Core features of adolescent UCLA PEERS program adapted for young adults. Intervention used Socratic questioning to draw information from group.</p> <p><i>Control</i></p> <p>Wait list</p>	<p><i>Primary Outcome Measures</i></p> <ul style="list-style-type: none"> • SRS • SSRS • SELSA. <p><i>Secondary Outcome Measures</i></p> <ul style="list-style-type: none"> • EQ • OSQ • SSI • TYASSK. 	<p><i>Script fading procedures:</i> The procedures appear promising, but there is not enough research to tell.</p> <p><i>Video modeling:</i> Participants in 2 of 3 studies showed significant improvements.</p> <p><i>Self-help skills:</i> Participants showed positive outcomes in 5 of 6 studies.</p> <p>MANOVA of outcome measures revealed multivariate main effect of group differences (intervention group improved significantly more than control group; $p < .02$).</p> <p>Intervention group also improved significantly more than control group in total scores on SELSA ($p < .05$), TYASSK ($p < .01$), SRS ($p < .04$), and SSRS ($p < .01$).</p> <p>Univariate analyses revealed statistically significant differences in ASD symptoms on the SRS in intervention group compared with control group, with an increase in Social Communication ($p < .04$) and a decrease in Autistic Mannerisms ($p < .02$).</p> <p>Intervention group also showed significant improvements on the SSRS compared with the control group for Cooperation ($p < .02$) and Assertion ($p < .05$).</p> <p>Mann–Whitney U tests were used to assess change in caregiver-reported get-togethers over the previous month. Intervention group had a significantly greater increase in invited get-togethers ($p < .03$) and hosted get-togethers ($p < .05$).</p>
Herbrecht et al. (2009)	<p>Level III</p> <p>One-group pretest–posttest</p> <p>$N = 17$ (15 male, 2 female; M age = 14.7 yr; age range = 9.3–20.3 yr).</p> <p>Autism group, $n = 6$.</p>	<p><i>Intervention</i></p> <p>KONTAKT. 4 psychiatrists–psychologists led the groups and met with parents 3x during intervention period to provide instruction over school holidays.</p> <p><i>Child groups:</i> Met 1 hr weekly for 11 mo.</p>	<p><i>Expert Opinion</i></p> <ul style="list-style-type: none"> • DCL, checklist for group behavior, GAF • Coded blind expert rating. <p><i>Parent Report</i></p> <ul style="list-style-type: none"> • PIA–CV–mini, which includes 6 domains: Social (PIA–S), affective 	<p>ANCOVA results indicated significant changes from pre- to posttest for DCL–social interaction ($p = .00$, $\eta = 0.50$); DCL–communication ($p = .02$, $\eta = 0.30$); DCL–stereotyped repetitive behaviors and interests ($p = .00$, $\eta = 0.48$); GAF ($p = .00$, $\eta = 0.42$); and PIA–INT ($p = .02$, $\eta = 0.33$).</p>

(Continued)

Supplemental Table 1. Evidence for the Effectiveness of Social Skills Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Hillier, Fish, Siegel, & Beversdorf (2011)	AS group, $n = 6$. PDD-NOS group, $n = 5$.	<i>Adolescent groups:</i> Met 1.5 hr 2x/wk for 11 mo.	<p>reactivity (PIA-AR), interaction with peers (PIA-INT), communication (PIA-K), stereotyped behavior (PIA-ST), and need for sameness (PIA-GL).</p> <ul style="list-style-type: none"> • Social Competence Scale • Family burden questionnaire. <p><i>Teacher Report</i></p> <ul style="list-style-type: none"> • Questionnaire for the assessment of group behavior 	These results indicate that KONTAKT may improve social skills, communication skills, and general functioning as well as decrease RRBs.
Hopkins et al. (2011)	Level III One-group pretest-posttest $N = 49$ (7 women, 42 men; M age = 21 yr; age range = 18–28 yr), 42 with Asperger syndrome, 6 with HFA, 1 with PDD-NOS.	<p><i>Intervention</i></p> <p>Aspirations program. 8 1-hr weekly meetings with 5–7 participants.</p> <p>Discussion-based format with focus on social and vocational skills (social communication, relationships, independent living, college, employment).</p>	<ul style="list-style-type: none"> • BDI-II • STAI • IPR. 	<p><i>BDI-II:</i> Significant reduction in depression from pretest to posttest with small effect size ($d = 0.24$).</p> <p><i>STAI:</i> Significant decrease in anxiety from pretest to posttest with small effect size ($d = 0.21$).</p> <p><i>IPR:</i> No significant difference, but trend toward improvement (58% reported improvement).</p>
	Level I RCT; 2 (training) \times 2 (group) \times 2 (time) mixed factorial design $N = 49$ (44 boys, 5 girls; M age = 10.17 yr; age range = 6.3 yr–15.1 yr), 24 with HFA (KBIT >70), 25 with LFA (KBIT <70). Intervention group, $n = 24$ (11 with LFA and 13 with HFA). Control group, $n = 25$ (14 with LFA and 11 with HFA).	<p><i>Intervention</i></p> <p>FaceSay 2x/wk for 10–25 min for 6 wk. Participants were reinforced with candy or praise for staying in their seat and interacting with program.</p> <p><i>Control</i></p> <p>Tux Paint (painting, coloring, and drawing program) at school for 10–25 min 2x/wk for 6 wk (12 sessions).</p>	<ul style="list-style-type: none"> • KBIT • Childhood Autism Rating Scale • Photographs of facial expressions • Benton Facial Recognition Test (Short Form) • SSRS • Social skills observation. 	<p>Intervention group performed better than control group on all measures.</p> <p><i>Emotion Recognition Skills</i></p> <p>For LFA intervention vs. LFA control, significant differences were found in total emotion recognition skills (photos and drawings; $p < .05$), emotion recognition (photos only; $p < .05$), but not emotion recognition (drawings only).</p> <p>Significant differences were found between HFA intervention and control groups in total emotion recognition ($p < .001$), photos only ($p < .001$), and drawings ($p < .01$).</p> <p><i>Facial Recognition Skills</i></p> <p>For LFA, no significant difference between intervention and control groups; for HFA,</p>

(Continued)

Supplemental Table 1. Evidence for the Effectiveness of Social Skills Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Kandaloff, Didehbandi, Krawczyk, Allen, & Chapman (2013)	Level III One-group pretest–posttest (pilot study) <i>N</i> = 8 (6 men, 2 women; age range = 18–26 yr) with AS or PDD–NOS.	<i>Intervention</i> 10 sessions of VR–SCT with 6-mo follow-up questionnaire. SecondLife used to develop VR technology. Participants logged in and were instructed by coach to interact with others in social scenarios (e.g., interviewing for a job, dealing with a roommate). Coach asked structured questions afterward, then provided education and feedback.	<i>Emotion Recognition</i> • ACS–SP <i>Theory of Mind</i> • Reading the Mind in the Eyes • Triangle (or Social Perception Task). <i>Conversation Skills</i> • SSPA <i>Functional Measure</i> • VR–SCT follow-up survey	intervention group had significantly higher scores on posttest than control group ($p < .01$). <i>Social Interaction Skills</i> Significant differences were found between LFA intervention and control groups in SSRS scores ($p < .01$) and social skills observation ($p < .05$). No significant differences were found for HFA intervention and control groups on SSRS scores ($p = .05$), but significant differences were found for social skills observation ($p < .001$). <i>ACS–SP</i> : All scores improved at posttest. <i>SP–Total</i> had significant increase ($p < .05$), as did <i>SP–Prosody</i> ($p < .05$); <i>SP–Affect Naming</i> and <i>SP–Pairs</i> increases were not significant. <i>Theory of Mind</i> : Increase in Triangle scores was significantly different ($p < .05$); increase in Reading the Mind in the Eyes scores was not significant; but scores improved. <i>Conversation skills</i> : No significant difference, but scores improved. <i>VR–SCT follow-up</i> : 100% of respondents would recommend it to others; 100% felt the intervention directly improved their ability to maintain a conversation.
Karkhaneh et al. (2010)	Level I Systematic review 6 clinical trials (4 RCTs and 2 CCTs) 22 electronic databases searched (MEDLINE, ERIC, CINAHL, etc.)	<i>Intervention</i> Social Stories <i>Control</i> Varied by study	Varied by study (game skills, reading comprehension, social skills, social isolation, echolalic communication)	5 of the 6 trials showed statistically significant benefits of Social Stories for improving social skills.

(Continued)

Supplemental Table 1. Evidence for the Effectiveness of Social Skills Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Kasari, Rotheram-Fuller, Locke, & Gulsrud (2012)	<p>Level I</p> <p>RCT; 2 × 2 factorial design (control, peer, child, and peer + child conditions)</p> <p><i>N</i> = 875 (<i>M</i> age = 8.14 yr), all fully included in school; 15 participants per group, block randomized by class and stratified on grade.</p> <p>Intervention group, <i>n</i> = 60 children with ASD in Grades 1–5.</p> <p>Control group, <i>n</i> = 815 TD children in the 56 classrooms that the participants were in.</p>	<p><i>Intervention</i></p> <p>12 sessions over 6 wk with 3-mo follow-up.</p> <p><i>CHILD</i>: Children with ASD met with interventionist for 20-min sessions to develop strategies for interacting with peers.</p> <p><i>PMI</i>: 3 TD children from the classroom met with interventionist for 20-min sessions and were taught to interact with classmates with ASD (but target child was never directly identified).</p> <p><i>Control</i></p> <p>No treatment</p>	<p><i>Primary Outcome Measures</i></p> <p>Social Network Survey, a measure of SNS, which is a ratio score for the prominence of a child in a classroom; playground observation of peer engagement</p> <p><i>Secondary Outcome Measures</i></p> <ul style="list-style-type: none"> • Indegrees (friendship nominations), outdegrees, rejects, and reciprocal relationships (from Social Network Survey) • TPSS. 	<p><i>SNS</i>: ANCOVA results of posttest compared with pretest indicate significant group effect on SNS scores ($p = .001$), with a significant main effect of PMI ($p = .004$, $d = 0.79$) and an interaction effect ($p = .05$).</p> <p>Marginally significant effect of CHILD ($p = .06$, $d = 0.36$).</p> <p>Follow-up scores indicated significant effect of intervention group ($p = .008$) and significant PMI × CHILD interaction effect ($p = .02$).</p> <p>CHILD + PMI group had significantly higher SNS at follow-up than CHLD group ($p = .014$, $d = 0.97$).</p> <p>Conditional HLM model indicated a significant PMI × Time interaction ($p = .02$) for playground engagement, but not for the CHLD group.</p> <p>No significant PMI × CHLD interaction was found.</p> <p>A post hoc ANCOVA indicated that solitary engagement ($p = .000$, $d = 0.94$) and joint engagement ($p = .005$, $d = 0.77$) were significantly better for PMI at follow-up.</p> <p>Indegrees showed a significant post-treatment effect ($p = .000$) with a significant main effect for PMI ($p = .02$, $d = 0.74$).</p> <p>No significant differences were found for outdegrees, rejections, or reciprocal friendships.</p> <p>A significant effect was found for TPSS from pretest to posttest ($p = .000$) with a main effect for UCLA PEERS ($p = .01$, $d = 0.44$).</p>

(Continued)

Supplemental Table 1. Evidence for the Effectiveness of Social Skills Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Koenig et al. (2010)	<p>Level I</p> <p>RCT</p> <p><i>N</i> = 44 children (10 girls, 34 boys; age range = 8–11 yr) with FSIQ \geq 70 randomly assigned to treatment or waiting list; no significant differences between groups. Diagnosis confirmed with ADOS, SCQ, and PDD–BI.</p> <p>Intervention group, <i>n</i> = 24 (7 with ASD, 6 with AD, 11 with PDD–NOS).</p> <p>Wait-list group, <i>n</i> = 18 (3 with autism, 3 with AD, 12 with PDD–NOS).</p>	<p><i>Intervention</i></p> <p>75-min session 1×/wk for 16 wk; each group had 4–5 participants and 2 peer tutors. Led by 2 licensed clinicians. Sessions included greeting, snack, review of rules, activity, snack, and closing. Fidelity Checklist followed by leaders, and videos of 25% of sessions reviewed for fidelity (\geq75%).</p> <p><i>Control</i></p> <p>Wait list</p>	<ul style="list-style-type: none"> • CGI–I • SCI • PSS. 	<p>The rate of response (<i>much improved</i> or <i>very much improved</i>) for CGI–I score was significantly higher for the intervention group than the wait-list group ($p = .001$), and children with AD were more likely than those with PDD–NOS to be responders ($p = .03$).</p> <p>No significant differences were found between baseline and endpoint SCI scores within groups or over time between groups.</p> <p>On the PSS, more than 90% of parents said their child liked the group.</p>
Kokina & Kern (2010)	<p>Level I</p> <p>Meta-analysis</p> <p>18 studies (15 articles, 3 dissertations)</p> <p>Found through search of PsycINFO and ERIC as well as several specific journals. For inclusion, studies had to use single-subject design with experimental control, include participants with ASD, and use Social Stories as the sole intervention. Qualitative and group design studies were excluded. 47 participants (33 with autism, 4 with Asperger syndrome, 10 with PDD–NOS; age range = 3–15 yr).</p>	<p><i>Intervention</i></p> <p>Social Stories (varied by study)</p> <p><i>Control</i></p> <p>Varied by study</p>	<p>PND for a variety of behaviors, depending on study.</p> <p><i>Main categories:</i></p> <ul style="list-style-type: none"> • Social skills • Challenging behaviors • Functional and academic behaviors • Participation in novel events or transitions. 	<p>Total median PND = 62% overall, mean of 60% (range = 11%–100%), indicating low to questionable effectiveness.</p> <p>Median PND = 87% for challenging behaviors, 56% for social behaviors (better for addressing challenging behaviors).</p> <p>Results were best when children read the story (median PND = 95%) than when the teacher, parent, or researcher read it (researcher = worst).</p> <p>A short intervention period (0–10 sessions) was better than a longer one.</p> <p>Having multiple stories was better than having 1, as was having illustrations.</p> <p>The intervention was better for elementary children than preschool children.</p>
Lerner & Mikami (2012)	<p>Level I</p> <p>RCT</p> <p><i>N</i> = 13 boys with HFASD + parents; diagnosis confirmed with SRS and SCQ.</p>	<p><i>Intervention</i></p> <p>90-min meetings 1×/wk for 4 wk; each meeting included 2 40-min sessions and used abridged versions of the curricula for SDARI. 10-min break between sessions was videotaped, and participants were given games to play.</p>	<ul style="list-style-type: none"> • SIOS • Sociometric nominations (children nominate friends) • SSRS–T and SSRS–P • SCQ • SRS. 	<p>For the SIOS, the SDARI group decreased significantly compared with the Skillstreaming group in both positive interactions ($p = .015$, $d = -1.17$) and negative interactions ($p = .048$, $d = -0.98$); there was no significant difference in low-level interactions.</p>

(Continued)

Supplemental Table 1. Evidence for the Effectiveness of Social Skills Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Lopata et al. (2010)	<p>Level I RCT N = 36 (age range = 7–12 yr) with HFASD (PDD–NOS, autism, or Asperger syndrome) stratified by age, gender, and ethnicity and then randomly assigned to group; IQ > 70, CASL score > 80. Treatment group, n = 18. Control group, n = 18.</p>	<p><i>Control</i> 90-min meetings 1x/wk for 4 wk; each meeting included 2 40-min sessions and used abridged versions of the curricula for Skillstreaming. 10-min break between sessions was videotaped, and participants were given games to play.</p> <p><i>Intervention</i> 5 daily 70-min intervention cycles (20-min social skills instruction + 50-min therapeutic activity). Social skills instruction = role-play and feedback; therapeutic activities provided practice and opportunity for reinforcement. Response–cost behavioral system used throughout intervention. Parents participated in weekly intervention groups (90 min). Intervention is very well defined in this article.</p> <p><i>Control</i> Wait list</p>	<ul style="list-style-type: none"> • ASC • SRS • BASC–2–PRS and BASC–2–TRS • Withdrawal and Social Skills scales • SKA • DANVA2 • Parent, child, and researcher satisfaction surveys • CASL • WISC–IV. 	<p>For the SRS–T, there was no significant Group × Time interaction but a significant effect of time ($p = .002$); both groups improved over time.</p> <p>No significant differences were found for the SRS–P and SRS or for sociometric nominations.</p> <p>For the SIOS general interaction (positive + negative + low-level interactions), the SDARI group had significantly higher baseline scores ($p = .016$) that decreased significantly over time compared with the Skillstreaming group ($p = .003$, $d = -1.80$)</p> <p>ANCOVA results for the parent-rating scales indicated significant differences for the SRS ($p = .003$, $d = 0.625$), ASC ($p = .006$, $d = 0.584$), and BASC–2 Withdrawal ($p < .001$, $d = 1.055$).</p> <p>There was no significant difference for parent-reported BASC–2 Social Skills.</p> <p>ANCOVA results for the child measures indicated significant between-groups differences for SKA ($p < .001$, $d = 1.272$) and CASL Idiomatic Language ($p < .001$, $d = 0.390$).</p> <p>DANVA2 results were not significant with Bonferroni adjustment ($p = .024$, $d = 0.532$).</p> <p>High levels of parent, child, and staff satisfaction were found.</p> <p>For the staff rating scales (intervention group only), ANOVA results indicate significant decreases on SRS ($p = .003$, $d = 0.711$), significant increases on ASC ($p < .001$, $d = 1.421$), and a significant increase on BASC–2 Social Skills ($p = .001$, $d = 0.776$).</p> <p>All results were in the expected direction.</p>

(Continued)

Supplemental Table 1. Evidence for the Effectiveness of Social Skills Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Ramdoss et al. (2012)	<p>Level I</p> <p>Systematic review</p> <p>11 studies; 330 participants</p> <p>Found through ERIC, MEDLINE, Psychology and Behavioral Sciences Collection, and PsycINFO.</p> <p><i>Inclusion criteria:</i> (1) primary intervention was delivered via computer and (2) ≥ 1 participant with ASD.</p> <p><i>Exclusion criteria:</i> studies (1) before 1990, (2) involving virtual technology, and (3) that used computer to deliver video model or with minimal user input.</p>	<p><i>Intervention</i></p> <p>Social competence and knowledge of emotional management, generating solutions to social conflicts, spontaneous greetings, facial processing, facial recognition, and teaching false belief tasks.</p> <p><i>Control</i></p> <p>Varied by study</p>	<p>Varied by study; some included parent questionnaires. A variety of effect sizes and NAP were used.</p>	<p>Social skills outcomes were all positive, with effect sizes ranging from small to large.</p> <p>Results for facial recognition were mixed (ranging from no difference to a very large difference).</p> <p>Results for recognition of emotion in human voices were mostly positive (ranging from no difference to large difference).</p> <p>Results were inconclusive for teaching false beliefs.</p>
Rao, Beidel, & Murray (2008)	<p>Level I</p> <p>Systematic review</p> <p>$N = 10$ articles (mix of single-subject and group designs).</p> <p>Found through PsycINFO, PsycARTICLES, ERIC, etc.</p> <p><i>Inclusion criteria:</i> ≤ 18 yr with AS or HFA, uses SST intervention, experimental research design, and direct measure of change in social skills.</p>	<p><i>Intervention</i></p> <p>Two main types, traditional SST and SST + generalization</p> <p><i>Control</i></p> <p>Varied by study</p>	<p>Varied by study.</p>	<p>70% of the 10 studies reported positive intervention effects.</p> <p>Lack of current evidence to support specific efficacy of SST for youths with HFA/AS.</p> <p>A wide variety of SST programs made it hard to establish efficacy.</p>
Reichow, Steiner, & Volkmar (2013)	<p>Level I</p> <p>Systematic review</p> <p>$N = 5$ studies; 196 participants.</p> <p>Found through CENTRAL, MEDLINE, EMBASE, PsycINFO, CINAHL, ERIC, Sociological Abstracts, OCLC WorldCat, Social Science Citation Index, and metaRegister of Controlled Trials.</p>	<p><i>Intervention</i></p> <p>Social skills groups</p> <p><i>Control</i></p> <p>Varied by study</p>	<p><i>Primary Outcome Measures</i></p> <p>Addressed social competence and were usually parent report (e.g., VABS or SSRS).</p> <p><i>Secondary Outcome Measures</i></p> <p>Addressed social communication, quality of life, emotion recognition, specific behaviors, and adverse effects, which were measured in different ways for each study.</p>	<p>There is some evidence that social skills groups may improve social competence ($p = .0003$, effect size = 0.47) and friendship quality ($p = .04$, effect size = 0.41) for individuals with ASD ages 6–21.</p> <p>No differences were found in emotion recognition, use of idioms in social communication, or child or parental depression; there were possible differences in loneliness (decreased loneliness in intervention group).</p>

(Continued)

Supplemental Table 1. Evidence for the Effectiveness of Social Skills Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Reynhout & Carter (2011)	<p>Level I</p> <p>Meta-analysis using 3 single-subject metrics: PEM, PND, and IRD</p> <p><i>N</i> = 61 articles reporting 62 studies; 174 participants (age range = 2–57 yr).</p> <p>Found through CINAHL, ERIC, Expanded Academic ASAP, MEDLINE, PsycINFO, ProQuest Dissertations and Theses, and manual searches of <i>JADD</i> and <i>Focus on Autism and other Developmental Disabilities</i>.</p> <p><i>Inclusion criteria:</i> (1) English, (2) located before October 2009, (3) used Social Stories intervention, (4) ≥1 participant with a disability, (5) small-<i>n</i> research design, (6) included data by session in words or graph, and (7) included data on learner performance.</p>	<p><i>Intervention</i></p> <p>Social Stories; 79% in compliance with Gray's (2000, 2002, 2003; Gray & Garand, 1993) guidelines</p> <p><i>Control</i></p> <p>Varied by study</p>	<p>Varied by study. Target behaviors included social skills, challenging behaviors, on-task behaviors, functional skills, and repetitive behaviors.</p>	<p>The mean PND for all studies = 51% (between not effective and mildly effective). Mean PEM for all studies = 72%. Mean IRD for all studies = 0.57.</p>
Schreiber (2011)	<p>Level I</p> <p>Systematic review</p> <p><i>N</i> = 38 studies found in ERIC and PsycINFO.</p> <p><i>Inclusion criteria:</i> (1) published in peer-reviewed journal from 2000 to 2009, (2) ≥1 participant with HFA or AS if aggregated data presented, and (3) participants ages 5–18 yr.</p>	<p><i>Intervention</i></p> <p>Social Stories, manualized instructional programs, nonmanualized training and support groups, cognitive-behavioral therapy, parent- or family-mediated therapy, peer-mediated therapy, activity-based therapy</p> <p><i>Control</i></p> <p>Varied by study</p>	<p>Varied by study; some with individual target behaviors, others with parent-report rating tools</p>	<p><i>Social Stories</i></p> <p>Social Stories are more effective with music involved and can help with extinguishing challenging behaviors and teaching prosocial behaviors; PowerCards variation capitalizes on child's interests.</p> <p><i>Manualized Instructional Programs</i></p> <p>Summer treatment program appeared effective per parent report but did not measure generalization.</p> <p>The SCORE (share ideas, compliment others, offer help or encouragement, recommend changes nicely, and exercise self-control) strategy resulted in 10%–50% gains; the SODA (stop, observe, deliberate, and act) strategy resulted in significant gains maintained for 5 mo; Junior Detectives resulted in gains of 1 standard deviation in intervention group compared with control group (but methodological flaws were noted); and UCLA PEERS results indicated significant gains in social</p>

(Continued)

Supplemental Table 1. Evidence for the Effectiveness of Social Skills Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
				<p>knowledge, frequency of get-togethers, and overall social competency (but some methodological flaws were noted).</p> <p><i>Nonmanualized Training and Support Groups</i></p> <p>Moderate effect sizes were found for changes in social competency and problem behaviors for a role-play based group (Tse, Strulovitch, Tagalakis, Meng, & Fombonne, 2007).</p> <p>Pilot study of Friendship Club showed increased self-esteem and social participation.</p> <p>Virtual environments are emerging as a training technique, but it may be difficult to transfer skills.</p> <p><i>Cognitive-Behavioral Therapy</i></p> <p>Significant improvements were noted in social skills and social interactions across several studies.</p> <p><i>Parent- or Family-Mediated Therapy</i></p> <p>Relationship Development Intervention (Gutstein et al., 2007) shows promise, but some methodological flaws were noted.</p> <p><i>Peer-Mediated Therapy</i></p> <p>Some evidence was found that these interventions are effective, but evidence of generalization is limited.</p> <p><i>Activity-Based Therapy</i></p> <p>LEGO therapy shows some promise, with 1 initial study and an independent replication with comparison with Social Use of Language Program; collaborative computer work may be effective for increasing social interaction (but only 1 case study and 1 qualitative study were found).</p>

(Continued)

Supplemental Table 1. Evidence for the Effectiveness of Social Skills Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Shukla-Mehta, Miller, & Callahan (2010)	Level I Systematic review 26 studies; <i>N</i> = 104 participants.	<i>Interventions</i> Included video modeling, video self-modeling, and point-of-view video modeling <i>Control</i> Varied by study	Outcome measures varied by study; target behaviors included scripted and unscripted verbalizations, engagement in play activities, conversational skills, prosocial behaviors, and spontaneous responding.	Video instruction was effective in most cases for improving target behaviors. Better acquisition, generalization, and maintenance were noted with reinforcement and error correction. Better results occurred when video content and length were tailored to child's skill level, child was able to attend for at least 1 min, and video was 3–5 minutes long.
Sowa & Meulenbroek (2012)	Level I Meta-analysis 16 studies; <i>N</i> = 133 participants, ages 4–41.3 yr (average age = 13.6 yr).	<i>Intervention</i> Jogging, swimming, horse riding, cycling and weight training, walking, and other. <i>Control</i> Varied by study	Outcome measures varied by study but included SP, SRS, and SQLS as well as aerobic fitness, muscle strength, and academic engagement.	Type of model did not matter, although video self-modeling was noted to be less efficient. Overall improvement score of 37.5%. Participants benefited most from individual interventions (<i>M</i> = 48.57%) rather than group interventions (<i>M</i> = 31.54%) (<i>r</i> = -0.32). Individual programs improved motor skills (<i>p</i> = .04, <i>r</i> = -0.31). Overall social skills improved (<i>p</i> = .000; effect size <i>r</i> = -0.62). However the individual programs (<i>M</i> = 71.43%) had a greater effect on social skills than groups (<i>M</i> = 26.37%).
Stichter, O'Conner, Herzog, Lierheimer, & McGhee (2012)	Level III One-group pretest–posttest <i>N</i> = 20 (19 boys, 1 girl; <i>M</i> age = 8.77 yr; age range = 6.75–10.83 yr), 6 with autism, 5 with AS, 6 with PDD-NOS, 3 with ASD (ADOS or ADI-R confirmed). <i>M</i> FSIQ score = 99.30 (<i>SD</i> = 15.18, range = 72–124)	<i>Intervention</i> 5 units of SCI-E, each containing 4 1-hr lessons (total = 20 hr). Units included recognizing facial expressions, sharing ideas, turn taking in conversations, recognizing feelings and emotions, problem solving. Each unit covered for 2 wk. <i>Lesson structure:</i> Review of previously learned skill, introduction of new skill, skill modeling, practice of skill, and closing activity and review.	<ul style="list-style-type: none"> SRS ToM tests (scored pass–fail except for the last one): Sally-Anne, Smarties, Friends ABC Story, Faux Pas Stories DANVA2-CF BRIEF TOPS 3: Elementary. 	Significant changes on SRS total score from pretest to posttest for both parent (<i>p</i> < .001, <i>d</i> = 0.75) and teacher (<i>p</i> < .05, <i>d</i> = 0.39) versions. Mixed results on first 3 ToM measures with some students passing at pretest but not at posttest; significant improvement in ability to recognize social faux pas on Faux Pas Stories (<i>p</i> < .01, <i>d</i> = 0.40). No significant difference was found on the DANVA2-CF.

(Continued)

Supplemental Table 1. Evidence for the Effectiveness of Social Skills Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Test, Richter, Knight, & Spooner (2011)	<p>Level I</p> <p>Meta-analysis</p> <p>28 articles found through ERIC, MasterFILE Premier, Primary Search, MiddleSearch Plus, PsycINFO, PsycARTICLES (and several other databases).</p> <p><i>Inclusion criteria:</i> Evaluated effect of Social Stories on a DV, published in peer-reviewed journal, and reported quantitative or qualitative results.</p> <p><i>Exclusion criteria:</i> Case-study design or did not investigate a Social Stories intervention as an IV.</p>	<p><i>Intervention</i></p> <p>Social Stories</p> <p><i>Control</i></p> <p>Varied by study</p>	<p>13 different categories of DVs identified; most studies measured improvements in social skills, decreases in inappropriate verbalizations, and interactions with others.</p>	<p>Significant increase on the BRIEF in metacognition ($p < .01$, $d = 0.26$) and regulation of behavior ($p < .05$, $d = 0.23$).</p> <p>Significant increase in TOPS sequencing events ability ($p < .05$, $d = 0.26$).</p> <p>Of the 6 studies, 5 were very effective (PND >90%) or effective (PND 70%–90%); interventions measured improvements in social skills.</p> <p>The results of 9 studies indicated a socially meaningful change in behavior.</p> <p>Not all studies adhered to Gray's (2003) guidelines for Social Stories but those that did had mixed results, so it may be that following the guidelines does not make a difference.</p>
Turner-Brown, Perry, Dichter, Bodfish, & Penn (2008)	<p>Level II</p> <p>Two groups, nonrandomized</p> <p>$N = 11$ adults with HFASD.</p> <p>Treatment group, $n = 6$.</p> <p>Control group, $n = 5$.</p>	<p><i>Intervention</i></p> <p>SCIT–A: Group meetings 1x/wk for 18 wk; each session ~50 min. Check-in, homework, and activities for each session. Video-based examples of social situations shown.</p> <p><i>Control</i></p> <p>Treatment as usual.</p>	<p>FEIT, The Hinting Task (tests ToM), SCSQ (self-report), SSPA (self-report)</p>	<p>Feasibility: Attendance was high (92% overall).</p> <p>Social cognition: 2×2 repeated-measures ANOVA revealed main effect of group on FEIT, with treatment group performing better than control ($p < .05$, $d = .94$ for treatment group). Main effect of time significant for Hinting Task ($p < .05$, $d = .84$ for treatment group).</p>
Walker, Barry, & Bader (2010)	<p>Level III</p> <p>One-group pretest–posttest</p> <p>$N = 12$ children with ASD (11 boys, 1 girl; M age = 4.42 yr; age range = 3–7 yr), 11 with autism, 1 with PDD–NOS.</p>	<p><i>Intervention</i></p> <p>4-wk summer camp (Speech-n-Motion) that was intended to increase social skills and peer interaction through play based on sensory–motor activities and language. 32 hr of intervention total (8 hr/wk over 2 4-hr sessions).</p>	<p>Adaptive Social Skills Measure, both parent- and therapist-report versions; developed by the authors</p>	<p>Significant improvements from pretest to posttest in parent-reported total score ($p < .05$), verbal communication ($p < .05$), and social interaction ($p < .05$).</p> <p>Significant improvements from pretest to posttest in therapist-reported total score ($p < .01$), verbal communication ($p < .01$).</p>

(Continued)

Supplemental Table 1. Evidence for the Effectiveness of Social Skills Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Wang & Spillane (2009)	<p>Level I</p> <p>Meta-analysis</p> <p><i>N</i> = 38 studies included (36 single-subject, 2 group designs) found through ERIC and PsycINFO; 147 participants with ASD (age range = 2–17 yr).</p> <p><i>Inclusion criteria:</i> (1) Participants ages birth–21; (2) students receiving special education; (3) outcome measures that target social skills; (4) addressed effectiveness of social skills intervention; (5) empirical, evidence-based investigation published between 1997 and 2008 (no dissertations); (6) met criteria for evaluating evidence-based strategies (Odom et al., 2005).</p>	<p><i>Intervention</i></p> <p>Social Stories, peer mediated, video modeling, cognitive-behavioral training, and "other" (ToM, PECS, scripts and cue cards, PRT, Keys to Play, and social skills training with scripts and reinforcement)</p> <p><i>Control</i></p> <p>Varied by study</p>	<p>PND used to evaluate effectiveness of intervention for single-subject design studies and effect size for group designs.</p> <p>Target behaviors varied by study and included maintaining and initiating conversation, maintaining and initiating social behavior, play skills, eye contact, and perspective taking. Some studies had >1 target behavior.</p>	<p>social interaction ($p < .01$), transitions ($p < .01$), and attention to task ($p < .01$).</p> <p>No significant differences in change scores between parents and therapists.</p> <p>For Social Stories, <i>M</i> PND score = 67.21 (range = 46.7%–100%); met criteria for EBP but PND scores are questionable.</p> <p>For PMI, <i>M</i> PND score = 60.69% (range = 35.09%–100%); questionable effectiveness due to low PND scores.</p> <p>For video modeling, <i>M</i> PND = 84.25 (range = 50%–100%); video modeling met EBP criteria and has good PND scores.</p> <p>Effect sizes for cognitive-behavioral therapy ranged from 0.59 to 0.24 for 1 article (low-moderate effect) and from 1.24 to 0.47 for another article (high-moderate effect).</p> <p>PND = 100% for 1 study.</p> <p>More studies needed to determine effects.</p> <p>Only 1–2 articles were cited for some interventions.</p> <p>ToM intervention is promising with PND = 80.77%.</p>
Wang, Cui, & Parrila (2011)	<p>Level I</p> <p>Meta-analysis</p> <p><i>N</i> = 14 single-subject-design studies included from 13 articles; 9 studies on PMIs and 5 on video modeling</p> <p>Articles found in Ovid, MEDLINE, PsycINFO, ERIC, Web of Science, TOC Premier.</p> <p><i>Inclusion criteria:</i> (1) at least half of participants with ASD, (2) DVs related to</p>	<p><i>Intervention</i></p> <p>Peer-mediated and video modeling interventions for social skills.</p> <p><i>Control</i></p> <p>Varied by study</p>	<p><i>M</i> effect size = 1.27 (<i>SD</i> = 0.43; range = 0.65–2.31).</p> <p>HLM analysis revealed effect sizes significantly different from zero (probably effective).</p> <p>Both peer-mediated and video modeling interventions were probably equally as effective (no effect of intervention).</p> <p>Age effect indicates interventions are slightly more effective for younger</p>	<p>(Continued)</p>

Supplemental Table 1. Evidence for the Effectiveness of Social Skills Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
White, Koenig, & Scathill (2007)	social skills and involved interaction with humans, (3) focus of the study to provide intervention, and (4) single-case research	<i>Intervention</i> Group social skills interventions <i>Control</i> Varied by study	Varied by study; included teacher and parent report as well as child self-report and behavioral observations; SSRS was the most frequently used (5 studies).	children (but not statistically significant; $p = .066$); this effect was mostly due to video modeling studies (not peer-mediated studies). Results organized by phases of studies (Phase 1 = technique refinement, Phase 2 = manual development, Phase 3 = RCT, Phase 4 = effectiveness studies); no Phase 4 studies were included. Results were mixed; some studies showed no change over time, some showed significant improvements, and several had no quantitative data. Several promising strategies were listed, such as use social scripts for common situations, reinforce response attempts, differentially reinforce positive behaviors.
White, Koenig, & Scathill (2010)	Level III One-group, pretest–posttest $N = 16$ (14 boys, 2 girls; M age = 12.55 yr, $SD = 1$ yr), 10 with AS, 3 with autism, 3 with PDD–NOS. 1 girl withdrew because of worsening of co-occurring bipolar disorder.	<i>Intervention</i> 16-wk program adapted from Social Development Program (manual-based curriculum for 8- to 11-yr-olds with ASD). Intervention has a high degree of structure, explicit teaching, verbal and visual aids, frequent repetition, and parent involvement. Behavioral and cognitive–behavioral strategies used. Peer tutor for each session.	<ul style="list-style-type: none"> • SRS parent and teacher report • SCI parent and teacher report • Parent Satisfaction Survey (adapted from version developed by NIH-sponsored Research Units in Pediatric Psychopharmacology Autism Network). 	For parent-reported SRS, significant improvements were found from pretest to posttest (for $n = 15$ with posttest data): Total score ($p < .05$, effect size = 0.93), Social Communication ($p = .02$, effect size = 1.04), Social Motivation ($p = .01$, effect size = 0.45). For teacher-reported SRS, no significant differences were found. For parent-reported SCI, significant improvement was found on Social Initiation ($p < .05$, effect size = 0.51). For teacher-reported SCI, significant improvement was found in Social Initiative ($p < .05$, effect size = 0.78). Parent satisfaction ($n = 14$) was high overall, with some feeling that there were not enough sessions and 11 indicating they would recommend the program.

(Continued)

Supplemental Table 1. Evidence for the Effectiveness of Social Skills Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Zhang & Wheeler (2011)	Level I Meta-analysis 45 articles included. <i>N</i> = 118 children with ASD ages 0–8.	<i>Intervention</i> PMIs including peer modeling, peer initiation training, peer monitoring, peer networking, peer tutoring, and group-oriented contingencies. <i>Control</i> Varied by study	Outcome measures varied across studies and included social interactions and social responses.	PMIs for promoting social interactions among young children with ASD were highly effective, and effects lasted across time, settings, participants, and target behaviors or activities. This was especially true for ages 36–59 mo (<i>ES</i> = 1.78); when targeting young boys (<i>ES</i> = 1.53); using older siblings as interventionists (<i>ES</i> = 2.16); when the intervention occurred at home (<i>ES</i> = 2.23); when peer modeling (<i>ES</i> = 3.16) was used; when consideration was given to maintenance (<i>ES</i> = 1.54) and generalization across participants (<i>ES</i> = 1.46), behaviors (<i>ES</i> = 1.76), and activities (<i>ES</i> = 1.67); and when the intervention involved collaboration among researchers, peers/siblings, school staff, and parents/families (<i>ES</i> = 2.06). The <i>p</i> values for all these variables were <i>p</i> < .01.

Note. ACS-SP = Advanced Clinical Solutions for WAIS-IV and WMS-IV Social Perception Subtest; AD = autistic disorder; ADI-R = Autism Diagnostic Interview, Revised; ADOS = Autism Diagnostic Observation Schedule; ALQ = Achieved Learning Questionnaire; ANCOVA = analysis of covariance; ANOVA = analysis of variance; AS = Asperger syndrome; ASC = Adapted Skillstreaming Checklist; ASD = autism spectrum disorder; BASC-2-PRS = Behavior Assessment System for Children, Second Edition, Parent Rating Scale; BASC-2-TRS = Behavior Assessment System for Children, Second Edition, Teacher Rating Scale; BDI-II = Beck Depression Inventory II; BRIEF = Behavior Rating Inventory of Executive Function; CASL = Comprehensive Assessment of Spoken Language; CCT = controlled clinical trials; CGI-I = Clinical Global Impressions Scale–Improvement item; CHLD = child-assisted intervention; CSBQ = Children’s Social Behavior Questionnaire; DANVA2 = Diagnostic Analysis of Nonverbal Accuracy 2; DANVA2-CF = DANVA2 Child Facial Expressions; DCL = Diagnostic Checklist for PDD; DV = dependent variable; EBP = evidence-based practice; EQ = Empathy Quotient; ES = effect size; FEIT = Face Emotion Identification Test; FSIQ = full scale intelligence quotient; GAF = Global Assessment of Functioning scale; HFA = high-functioning autism; HFASD = high-functioning autism spectrum disorder; HLM = hierarchical linear modeling; IPR = Index of Peer Relations; IRD = difference between improvement rates for all phases; IV = independent variable; JA = joint attention; JADD = *Journal of Autism and Developmental Disorders*; KBIT = Kaufman Brief Intelligence Test; KONTAKT = Frankfurt Social Skills Training; LFA = low-functioning autism; developmental disorder—not otherwise specified; PECS = Picture Exchange Communication System; PEM = percentage of data points that exceed the median in the predicted direction; PIA-CV–mini = Parent Interview for Autism–Clinical Version; PMI = peer-mediated intervention; PND = percentage of nonoverlapping data points; PRT = pivotal response training; PSS = Parent Satisfaction Survey; QSQ = Quality of Socialization Questionnaire; RCT = randomized controlled trial; RRB = restricted and repetitive behavior; SCDS = Social Competence Development Scale; SCL-E = Social Competence Intervention–Elementary; SCT–A = Social Cognition and Interaction Training for ASD; SCQ = Social Communication Questionnaire; SCSQ = Social Communication Skills Questionnaire; SD = standard deviation; SDARI = sociodramatic affective-relational intervention; SELSA = Social and Emotional Loneliness Scale for Adults; SIOS = Social Interaction Observation System; SKA = Skillstreaming Knowledge Assessment; SMS = social network salience; SP = Sensory Profile; SPPC = Self-Perception Profile for Children; SOLS = Stress and Quality of Life Scale, SRS = Social Responsiveness Scale; SSG = social skills group; S.S.GRIN = Social Skills Group Intervention; SSI = Social Skills Inventory; SSPA = Social Skills Performance Assessment, Version 3.2; SSRS = Social Skills Rating System; SSRS-P = SSRS–Parent Version; SSRS-T = SSRS–Teacher Version; SST = social skills training; TD = typically developing; STAI = State-Trait Anxiety Inventory; ToM = Theory of Mind; TOPS 3 = Test of Problem Solving 3; TPSS = teacher perception of social skills; TYASSK = Test of Young Adult Social Skills Knowledge; UCLA PEERS = University of California, Los Angeles, Program for the Education and Enrichment of Relational Skills; VABS = Vineland Adaptive Behavior Scales; VR = virtual reality; VR–SCT = Virtual Reality Social Cognition Training; WAIS-IV = Wechsler Adult Intelligence Scale, Fourth Edition; WISC-IV = Wechsler Intelligence Scale for Children, Fourth Edition; WMS = Walker–McConnell Scale of Social Competence and Social Adjustment.

This table is a product of AOTA’s Evidence-Based Practice Project and the *American Journal of Occupational Therapy*. Copyright © 2015 by the American Occupational Therapy Association. It may be freely reproduced for personal use in clinical or educational settings as long as the source is cited. All other uses require written permission from the American Occupational Therapy Association. To apply, visit www.copyright.com.

Suggested citation: Tanner, K., Hand, B. N., O’Toole, G., & Lane, A. E. (2015). Effectiveness of interventions to improve social participation, play, leisure, and restricted and repetitive behaviors in people with autism spectrum disorder: A systematic review (Suppl. Table 1). *American Journal of Occupational Therapy*, 69, 6905180010. <http://dx.doi.org/10.5014/ajot.2015.017806>

Supplemental Table 2. Evidence for the Effectiveness of Social Communication Interventions for People With ASD

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Brunner & Seung (2009)	Level I Systematic review Studies primarily included children with autism.	<i>Intervention</i> ABA, naturalistic behavioral approaches, developmental interventions, classroom-based interventions, video modeling, social skills interventions, AAC <i>Control</i> Varied by study	<ul style="list-style-type: none"> • IQ • Adaptive behavior • Language • JA • Initiating • Symbolic play • Turn-taking • Use of nonimitative words • Requesting • Elimination of negative behaviors • Spontaneous verbalizations • Autism symptom severity. <p><i>Quality Measures</i> Robey's (2004) 5-phase model for outcome research</p>	<p>Empirical evidence exists for some communication-based interventions targeting social behaviors in ASD.</p> <p>When determining the most efficacious treatment approach, individual child characteristics such as age, verbal abilities, level of functioning, JA, history of symptom regression, and object exploration should be considered; combining evidence-based treatments may also be indicated.</p> <p>For the improvement of verbal skills and communication, ABA, naturalistic, and AAC interventions are best validated.</p> <p>For improvement of social skills, video and peer-sibling modeling and developmental interventions are indicated.</p> <p>Limited support is apparent for social skills training, functional communication training, and classroom-based interventions.</p>
Flippin, Reszka, & Watson (2010)	Level I Meta-analysis Studies included at least 1 child participant (18 yr or younger).	<i>Intervention</i> Standard PECS; followed manualized procedures <i>Control</i> Varied by study	<ul style="list-style-type: none"> • <i>Communication</i>: % independent exchanges, % accuracy of exchanges, spontaneous language, % independent mands, initiations, use of PECS, requesting • <i>Speech</i>: total utterances, % intelligible utterances, % spontaneous intelligible utterances, spontaneous speech, average spoken words/trial, word approximations, vocal approximations, frequency of speech, nonimitative words, and spoken acts. <p><i>Quality Measures</i> Rating scales adapted from Horner et al. (2005) and Wolf (1978). Provided in Appendixes. Separate rating scales used for single-subject and group designs.</p>	<p>PECS provided small to moderate improvements in communication outcomes in children with ASD, but speech improvements were more limited.</p> <p>Evidence to support the generalizability and maintenance of gains was lacking.</p> <p>PECS may be particularly useful in children presenting with low JA, low motor imitation, and high object exploration pretreatment.</p> <p><i>Communication Outcomes</i> Improvements noted in both study designs.</p> <ul style="list-style-type: none"> • <i>Single subject</i>: ES = 0.51, fairly effective intervention; limited study of maintenance and generalizability of gains. • <i>Group studies</i>: ES not calculable; poor results in those studies examining maintenance and generalizability.

(Continued)

Supplemental Table 2. Evidence for the Effectiveness of Social Communication Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Ganz, Davis, Lund, Goodwyn, & Simpson (2012)	Level I Meta-analysis Participants must have been diagnosed with autism.	<p><i>Intervention</i> PECS</p> <p><i>Control</i> All single case study design studies with participant serving as own control</p>	Differential outcomes based on the following attributes: (1) targeted outcomes—functional communication; (2) nontargeted outcomes— challenging behaviors, socialization, speech production; (3) age of individual; (4) disability category; and (5) PECS phase completed.	<p><i>Speech Outcomes</i></p> <ul style="list-style-type: none"> • <i>Single subject</i>: Small, nonsignificant gains, ES = 0.17; maintenance and generalization of gains reported, but in limited studies. • <i>Group designs</i>: ES not calculable; reports mixed, improvements and no improvements; gains not maintained in 6-mo follow-up. <p><i>Moderating Variables</i></p> <ul style="list-style-type: none"> • <i>Communication outcomes</i>: PECS more effective than comparison interventions when JA and motor imitation skills are decreased and object exploration skills are increased pretreatment. • <i>Speech outcomes</i>: Gains more likely to be maintained at 6 mo if object exploration was better pretreatment.
			Differential outcomes based on the following attributes: (1) targeted outcomes—functional communication; (2) nontargeted outcomes—challenging behaviors, socialization, speech production; (3) age of individual; (4) disability category; and (5) PECS phase completed.	<p>PECS showed modest effects on nontargeted behaviors such as challenging behavior, socialization, and speech production. These effects were optimized in younger children and children with comorbid intellectual disability. Much of the interpretation was limited by a small number of studies and observation points.^a</p> <ul style="list-style-type: none"> • <i>Socialization</i>: Overall IRD = 0.73 (large effect) • <i>Challenging behaviors</i>: Overall IRD = 0.61 (moderate effect) • <i>Age (nontargeted behaviors combined)</i>: preschool IRD = 0.48, elementary IRD = 0.44, secondary IRD = 0.32, all small; questionable effects • <i>Disability group (nontargeted behaviors combined)</i>: autism-only IRD = 0.43 (small effect), autism + ID IRD = 0.64 (moderate effect)

(Continued)

Supplemental Table 2. Evidence for the Effectiveness of Social Communication Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Gordon et al. (2011)	<p>Level I</p> <p>Secondary analysis of group RCT (classes randomized rather than children)</p> <p>$N = 84$ children with autism ages 4–10 yr from 17 classes. All had an intellectual disability and limited functional language.</p> <p>Intervention group, $n = 26$.</p> <p>Delayed-treatment group, $n = 30$.</p> <p>No-treatment group, $n = 28$.</p>	<p><i>Intervention</i></p> <p>PECS in the classroom delivered by trained teachers and monitored by PECS consultants.</p> <p><i>Control</i></p> <p>Delayed-treatment group received PECS 9 mo later.</p> <p>No-treatment group did not receive PECS. Control groups received standard classroom intervention based on an eclectic approach.</p>	<ul style="list-style-type: none"> • <i>Classroom Observation Schedule for Measuring Intentional Communication</i> (developed for the study) • <i>Communication observed during snack time</i>: frequency of child-initiated communication; frequency of use of different communication modalities—card, vocalization; and type of communication—request, social interaction. 	<ul style="list-style-type: none"> • <i>PECS phase completed (nontargeted behaviors combined)</i>: 1st 3 phases, $IRD = 0.78$ (large effect); 1st 4 phases, $IRD = 0.33$ (small effect); all 6 phases $IRD = 0.45$ (small effect). <p>PECS groups improved in initiation of all forms of communication.</p> <p>ESs ranged from 77% to 374% increase in observed behaviors.</p> <p>No improvements were observed in communication for the purpose of social interaction.</p> <p>Autism symptom severity and expressive language pretreatment moderated intervention outcome.</p>
Green et al. (2010)	<p>Level I</p> <p>RCT through 3 specialist centers at 12 different local primary care trusts</p> <p>At baseline, $N = 152$ children—families with core autism ages 2–4.11 yr, all attending specialist centers for treatment; at endpoint, 146 children.</p>	<p><i>Intervention</i></p> <p>PACT, a parent-child communication-focused intervention. One-on-one clinic session between parent and therapist with child present.</p> <p>Intervention involved an initial orientation meeting, then biweekly 2-hr clinic sessions for 6 mo and monthly booster sessions for 6 mo. Between sessions, families were asked to practice for 30 min/day.</p> <p>Treatment as usual provided by local services continued.</p> <p><i>Control</i></p> <p>Treatment as usual by local services.</p>	<ul style="list-style-type: none"> • ADOS-G algorithm • Parental synchronous responses to child • Child initiations with parents • Parent-child shared attention 	<p>At 13-mo endpoint, severity of symptoms on the ADOS-G algorithm was reduced by 3.9 points ($SD = 4.7$) in the intervention (PACT) group and by 2.9 ($SD = 3.9$) in the treatment-as-usual group, which represented a between-groups ES of -0.24 (95% CI [0.59, 0.11]) after adjustment for center, sex, verbal and nonverbal abilities, age, and socioeconomic status.</p> <p>Secondary outcomes included positive effects for parental synchronous responses to child (1.22; 95% CI [0.85, 1.59]), child initiations with parents (0.41; 95% CI [0.08, 0.74]), and parent-child shared attention (0.33; 95% CI [-0.22, 0.68]).</p> <p>No p scores were provided for primary outcome.</p>

(Continued)

Supplemental Table 2. Evidence for the Effectiveness of Social Communication Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Howlin, Gordon, Pasco, Wade, & Charman (2007)	Level I Group RCT (classes randomized rather than children) <i>N</i> = 84 children with autism ages 4–10 yr from 17 classes. All had an intellectual disability and limited functional language. Intervention group, <i>n</i> = 26. Delayed-treatment group, <i>n</i> = 30. No-treatment group, <i>n</i> = 28.	<i>Intervention</i> PECS in the classroom delivered by trained teachers and monitored by PECS consultants. <i>Control</i> Delayed-treatment group received PECS 9 mo later. No-treatment group did not receive PECS. Control groups received standard classroom intervention based on an eclectic approach.	<ul style="list-style-type: none"> • <i>Classroom Observation Schedule for Measuring Intentional Communication</i> (developed for the study) • <i>Communication observed during snack time</i>: frequency of child-initiated communication; frequency of use of different communication modalities—card, vocalization; and type of communication—request, social interaction. • <i>Standardized measures of expressive and receptive language</i>: Expressive One Word Picture Vocabulary Test, British Picture Vocabulary Scales. • <i>ADOS-G</i>: Communication and Reciprocal Social Interaction domain scores. 	Main effects of treatment observed for rate of communication initiations (2.73× more likely to be in a higher initiation category than no-treatment group) and rate of PECS use (3.90× more likely to be in a higher PECS use category than no-treatment group). These effects were not maintained at 10 mo possibly because scores were from 1 treatment classroom. No effects were observed on rate of speech. No immediate effect of treatment on ADOS-G Communication or Reciprocal Social Interaction scores, but the treatment groups were 3.57× more likely to be in a less severe Reciprocal Social Interaction category 10 mo after treatment. No significant effect on language scores.
Ingersoll (2010)	Level I RCT <i>N</i> = 22 children with autism ages 27–47 mo. One child from control group withdrew prior to intervention.	<i>Intervention</i> RIT; fidelity measure used <i>Control</i> Usual care	<ul style="list-style-type: none"> • Motor Imitation Scale—elicited imitation • Unstructured Imitation Assessment—spontaneous imitation. 	Treatment group made significantly more improvements than control group on both elicited and spontaneous imitation in both object and gesture conditions. Pretreatment play skills had an impact on level of gains made. Children with better play skills improved the most.
Ingersoll (2012)	Level I RCT; study was an extension of Ingersoll (2010) <i>N</i> = 29 children with autism ages 27–47 mo. Two children from control group and 1 from treatment group withdrew.	<i>Intervention</i> RIT; fidelity measure used <i>Control</i> Usual care	<ul style="list-style-type: none"> • ESCS • Bayley Social–Emotional Questionnaire • Motor Imitation Scale—elicited imitation • Unstructured Imitation Assessment—spontaneous imitation. 	Treatment group made significant gains in JA initiation and social–emotional skills relative to controls. Imitation skills were not supported as a primary mediating factor in treatment outcomes.
Kaale, Smith, & Sponheim (2012)	Level I RCT	<i>Intervention</i> Regular preschool programming: full day; 1:1 support for children with ASD; ABA or	Frequency of child-initiated higher order JA during ESCS, mother–child play, and pre-school teacher–child play.	JA improved significantly in intervention group compared with control group during teacher–child play (<i>d</i> = 0.44).

(Continued)

Supplemental Table 2. Evidence for the Effectiveness of Social Communication Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
	<i>N</i> = 61 children with autism ages 29–60 mo and attending preschool. 2 children from intervention group received only part intervention.	eclectic philosophical approach; children mostly mainstreamed, but some in ASD-specific unit. <i>JA program</i> : modified from Kasari, Freeman, & Paparella (2006). <i>Control</i> Regular preschool programming only.	<ul style="list-style-type: none"> • <i>JA</i>: ESCS • <i>JA and JE</i>: Preschool teacher–child play and mother–child play—videotaped play session, coded according to set criteria for each construct. 	<p><i>JE</i> improved significantly in intervention group compared with control group during mother–child play ($d = 0.67$).</p> <p>No significant differences were found in <i>JA</i> on ESCS, <i>JE</i> during teacher–child play, or <i>JA</i> during mother–child play (approached significance).</p> <p>Chronological age, language age, DQ, and program philosophy did not moderate the effect of <i>JA</i> intervention.</p>
Kasari, Gulsrud, Wong, Kwon, & Locke (2010)	Level I RCT <i>N</i> = 38 toddlers with autism and their caregivers; 19 were randomized to wait-list control. Toddlers were younger than 36 mo.	<i>Intervention</i> Modified from Kasari et al. (2006, 2008) Delivered 3×/wk for 8 wk. Interventionists were trained graduate students. Intervention focused on training caregiver in play interactions with child with opportunity for practice and feedback. Influenced by developmental and behavioral philosophies. <i>Control</i> Usual care while on wait list.	<ul style="list-style-type: none"> • <i>JE</i>: Caregiver–child play; 5-min videotaped free play with standard toys coded for percentage of time in engagement, based on following categories: unengaged—other engagement, object engagement, <i>JE</i> • <i>Play</i>: Used same videos as above and coded for function and symbolic play acts • <i>JA</i>: coded using same videos; coded <i>JA</i> initiation and responding • Caregiver Quality of Involvement Scale rated by researchers at each session. • <i>Parent adherence and competence</i>: Self-report by parents at each session • <i>Service utilization measure</i>: Parent questionnaire tracking other interventions used and hours spent on these during program; completed at each session. 	<p>Intervention group engaged in significantly less object-focused play ($d = 1.09$) and significantly more <i>JE</i> ($d = 0.87$) than wait-list controls. Large ESSs.</p> <p>No significant differences between groups on frequency of unengaged play.</p> <p>Intervention group showed significantly more responsiveness to <i>JA</i> ($d = 0.74$) but no difference on initiation of <i>JA</i>.</p> <p>Intervention group showed significantly more functional play than control group ($d = 0.88$).</p> <p>No differences were found in symbolic play.</p> <p>Treatment gains were maintained for <i>JA</i> and improved for functional play at 1-yr follow-up.</p> <p>Caregiver quality of involvement significantly predicted increased <i>JE</i> but not other outcomes.</p> <p>Parent adherence and competence and service utilization were not predictive of treatment outcomes.</p>
Kasari, Paparella, Freeman, & Jahromi (2008)	Level I RCT <i>N</i> = 56 children with autism ages 3–4 yr randomized to one of three groups: <i>JA</i>	<i>Intervention</i> All children received an intensive (30 hr/wk) behavioral intervention.	<ul style="list-style-type: none"> • ESCS • Structured Play Assessment • <i>Mother–child play interaction</i>: 15-min videotaped free play with standard toys • Service utilization questionnaire. 	<p>Both intervention groups (<i>JA</i> and play) showed significant improvement in <i>JA</i> initiation at all follow-up points when compared with control group. Large ESSs.</p>

(Continued)

Supplemental Table 2. Evidence for the Effectiveness of Social Communication Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Landa, Holman, O'Neill, & Stuart (2011)	<p>(<i>n</i> = 20), symbolic play (<i>n</i> = 19), and control (<i>n</i> = 17).</p> <p>This study reports follow-up data at 6 and 12 mo postintervention. 3 children were lost to 12-mo follow-up (2 in play group, 1 in control group).</p>	<p><i>JA</i>: Based on Kasari et al. (2006). Involved 30 min/day of targeted <i>JA</i> instruction using behavioral and developmental approaches.</p> <p>Symbolic play: 30 min/day of targeted symbolic play instruction without <i>JA</i>.</p> <p>All delivered daily for 5–6 wk by trained graduate students.</p> <p><i>Control</i> Intensive behavioral treatment only.</p>	<p>Baseline, postintervention, and 6-mo follow-ups conducted.</p> <ul style="list-style-type: none"> • <i>Communication and Symbolic Behavior Scales (Wetherby)</i>: initiation of <i>JA</i> and shared positive affect • <i>Socially engaged imitation</i>: With examiner, coded by video. 	<p>No differences were observed between groups on change in <i>JA</i> responding over time.</p> <p>Both intervention groups (<i>JA</i> and play) showed significant improvement in <i>JA</i> initiation at all follow-up points when compared with control group. Large ESSs.</p> <p>Play group improved the most in types of symbolic play engaged in over time, particularly noted in mother–child interaction.</p> <p>Play group achieved higher levels of play over time than both other groups.</p>
Landa, Esposito, Conson, Russo, & Massagli (2012)	<p>Level I RCT</p> <p><i>N</i> = 48 toddlers with autism ages 21–33 mo; nonverbal mental age of ≤8 mo.</p> <p>Stratified randomization; participants matched 1st on cognitive level.</p>	<p><i>Intervention</i> Classroom-based for 2.5 hr/day, 4 days/wk for 6 mo.</p> <p>Both groups received a comprehensive developmental curriculum.</p> <p>Intervention group received greater focus on opportunities for social interaction, initiation of <i>JA</i>, social modeling, etc. Parent education and home-based parent training classes offered to both groups.</p> <p><i>Control</i> Same intervention, with the exception of the supplementary social curriculum.</p>	<p>Griffiths Mental Developmental Scales, Language and Personal–Social subscales</p> <ul style="list-style-type: none"> • Vineland Adaptive Behavior Scales (VABS; 2nd ed.). Social subscale • Unstructured free play with examiner—15-minute unstructured play session reviewed for cooperative play, eye contact, <i>JA</i>, requests, and initiations. 	<p>Socially engaged imitation improved significantly in the intervention group but the not the control group throughout treatment period. Gains were maintained at 6-mo follow-up.</p> <p>No significant differences were noted in changes to initiated <i>JA</i> or shared positive affect between groups.</p> <p>Intervention group showed more rapid growth over time across all outcomes during intervention period, whereas control group showed significant growth only in expressive language (secondary outcome).</p>
Lerna, Esposito, Conson, Russo, & Massagli (2012)	<p>Level II</p> <p>Nonrandomized, 2-group, pre- and posttest.</p> <p><i>N</i> = 18 children (17 male) with ASD and little functional language ages 18–60 mo (<i>M</i> age = 38.78 mo)</p>	<p><i>Intervention</i> PECS, delivered in 3 30-min sessions/wk for 6 mo; trained therapists delivered in clinic setting following strict PECS guidelines</p> <p><i>Control</i> Conventional Language Therapy, delivered at the same frequency and in similar setting as PECS; experienced therapists.</p>	<p>Griffiths Mental Developmental Scales, Language and Personal–Social subscales</p> <ul style="list-style-type: none"> • Vineland Adaptive Behavior Scales (VABS; 2nd ed.). Social subscale • Unstructured free play with examiner—15-minute unstructured play session reviewed for cooperative play, eye contact, <i>JA</i>, requests, and initiations. 	<p>PECS group improved significantly more on VABS social, cooperative play, joint attention, requests, and initiation.</p> <p>No difference between groups on other standardized measures or eye contact.</p> <p>Control condition did not result in significant differences on any measure between Time 1 and Time 2.</p>

(Continued)

Supplemental Table 2. Evidence for the Effectiveness of Social Communication Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Oosterling et al. (2010)	<p>Level I</p> <p>Semi-RCT</p> <p>Intervention group, $n = 36$ (75.0% male; M age = 35.2 mo), 91.7% with ASD, 8.3% with PDD-NOS.</p> <p>Control group, $n = 31$ (80.6% male, M age = 33.3 mo), 83.9% with ASD, 16.1% with PDD-NOS.</p>	<p><i>Intervention</i></p> <p>Focus parent training was delivered in a 2-yr program including 4 group sessions delivered 2 hr weekly, 3-hr home visits every 6 wk (first year) and every 3 mo (second year), and plenary sessions every 6 mo. Training was eclectic in approach and aimed to promote child engagement, social communication, and language development.</p> <p>Usual specialized day care program.</p> <p><i>Control</i></p> <p>Usual specialized day care program only.</p>	<ul style="list-style-type: none"> • MacArthur-Bates Communicative Development Inventories for language production and comprehension • ADOS Modules 1 and 2 • Gesture use and early social communication skills. 	<p>No significant effects were found for the introduction of Focus parent training. However, improvements were noted in the children who had a $DQ \geq 50$, who demonstrated increased compliance, and for children with a $DQ \geq 70$, who demonstrated a decrease in avoidance, in the intervention group.</p>
Ospina et al. (2008)	<p>Level I</p> <p>$N = 101$ studies (55 RCTs, 32 CCTs, 4 prospective cohort studies, and 10 retrospective cohort studies)</p> <p>$N = 2,566$ participants (median sample size = 22, median age = 62 mo; age range included <6 yr in 76% of studies; 6–12 yr in 44%; 13–18 yr in 25%, and >18 in 11%), autism in 93% of the studies; Asperger syndrome, 14%; high-functioning autism, 5%; atypical autism, 2%; autism not yet diagnosed, 1%; and other ASD-related descriptions, 3%.</p>	<p><i>Intervention</i></p> <p>Eight broad types, lasting from 1 day to 9 yr: (1) ABA, (2) communication-focused interventions, (3) contemporary ABA, (4) developmental approaches, (5) environmental modification programs, (6) integrative programs, (7) sensory-motor, and (8) social skills development.</p> <p>Information about the provider of the intervention is limited.</p> <p><i>Control</i></p> <p>Varied by study</p>	<p>Some studies used validated measures. However, only 1 was mentioned, the Wechsler Intelligence Scale for Children-Revised. Other studies more commonly used less reliable measures; the 1 mentioned was Reynell Developmental Language Scales.</p>	<p>Despite indicating that no one intervention can improve all core symptoms, the meta-analysis indicated the following:</p> <ul style="list-style-type: none"> • Developmental approaches based on initiative interaction were significantly more effective than such approaches based on contingency interaction when considering time spent in stereotyped behaviors and distal social behavior. • No difference between Lovaas and special education when considering nonverbal intellectual functioning. • No difference between Lovaas and DIR when considering difference relating to communication skills. • No difference between computer-assisted instruction vs. no treatment when considering facial expression recognition • No difference between TEACCH vs. standard care on measures of imitation skills and eye-hand integration.

This review did not identify best practice in this area.

(Continued)

Supplemental Table 2. Evidence for the Effectiveness of Social Communication Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Seida et al. (2009)	Level I Umbrella review of systematic reviews evaluating the effectiveness of psychosocial treatments for individuals with autism. <i>N</i> = 30 studies published up to 2007. Participants in studies included preschool age through adulthood.	<i>Intervention</i> Psychosocial intervention, defined as any nonpharmacological treatment aimed at improving functioning of person with any of the impairments characteristic of ASD, included interventions based on or aimed at behavioral theory, communication-focused, parent mediated, sensory-motor (auditory integration training and music therapy), social skills development, and other (self-management intervention). <i>Control</i> Varied by study	The OQAQ was used by 2 reviewers to assess the quality of the systematic reviews. Evidence tables were used to synthesize findings and recommendations. A post hoc regression analysis examined characteristics to predict methodological quality and variables. A simple linear regression was initially conducted to examine the ability of each factor to predict the overall 7-point OQAQ score. A backward-elimination multiple linear regression using statistically significant predictor variables was then conducted.	No specific behavioral and developmental intervention definitively improves all core symptoms for all people with ASD; thus, clinicians must be guided by individual needs and availability of resources. However, particular interventions can benefit particular children and families. Only 5 reviews were considered high quality (minimal or minor flaws). The review of facilitative communication did not support its use for people with communication impairments; 2 reviews of parent-mediated interventions concluded they have some benefits; the review of auditory integration training concluded that the evidence to support its use was insufficient at present; and the review of music therapy indicated that it may help children with ASD improve their communication skills. Currently, some evidence supports a variety of interventions for ASD; however, clinical findings should currently be regarded as tentative until further high-quality primary studies are done.
Vismara, Colombi, & Rogers (2009)	Level III Before-after, nonconcurrent multiple-baseline design <i>N</i> = 8 toddlers (ages 10–36 mo) newly diagnosed with autism, also receiving 1 hr of speech therapy and occupational therapy and weekly 30-min participation in play group activities.	<i>Intervention</i> Early Start Denver Model: parent-implemented, 12 weekly 1-hr consecutive sessions, with 1 parent-caregiver, child, and therapist videotaped for analysis. Follow-up was 4 1-hr sessions to assess maintenance and generalization. <i>Control</i> No control: multiple baseline design with participants as their own control.	Social communication measures: All targeted behaviors were transcribed, and agreement was defined as both observers recording the same verbal utterance and imitative behavior. Reliability rating was 85% (range = 76%–100%) for spontaneous verbal utterances and 93% (range = 78%–100%) for imitative behaviors.	At baseline, all children displayed almost no verbal production and imitative behaviors during 10-min interactions. After commencing intervention, functional verbal responses increased, including spontaneous vocalization. Of 8 children, 7 demonstrated consistent increase in use of imitative behaviors. The children demonstrated the most gains after the parents achieved mastery of the intervention techniques, and gains continued to occur during the 3-mo follow-up period after termination of treatment.

(Continued)

Supplemental Table 2. Evidence for the Effectiveness of Social Communication Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Wong & Kwan (2010)	<p>Level I RCT</p> <p><i>N</i> = 17 children newly diagnosed with autism and their parents (chronological age = 17–36 mo; mental age = 11–23.5 mo); severity rating between 29.0 and 41.5.</p> <p>Intervention group, <i>n</i> = 9 (8 boys, 1 girl).</p> <p>Control group, <i>n</i> = 8 boys.</p>	<p><i>Intervention</i> 2 wk of a 5-day/wk personal tutoring program called Autism 1-2-3, an early intervention program aimed at teaching the children eye contact, gesture, and vocalization—words using 10 30-min sessions. Children received intervention between baseline and Time 1 assessment.</p> <p>Parents were trained to use the same techniques at home for 5–10 min every hour using toys (e.g., puzzles, tops, spiral speedways, shape sorters, toy garages, bubbles and balloons) similar to those used at the clinic.</p> <p><i>Control</i> Received the intervention between the Time 1 and Time 2 assessments.</p>	<ul style="list-style-type: none"> • ADOS Module 1—measures child communication and social interaction • Ritvo–Freeman Real Life Rating Scale—assesses parental perception of the social and communication behavior of their children • SPT—assesses child symbolic play behavior and the language potential of preverbal children. 	<p>Parents acquired the strategies for tools to engage their children, communicate with them, and teach them by the 5th–6th hour-long session, and these young children demonstrated sustained change and growth in social communication behaviors.</p> <p>Children in the control group did not demonstrate improvement until after receiving the intervention.</p> <p>Children in the intervention group improved significantly in their language and communication ($p = .007$).</p> <p>In reciprocal social interaction, the intervention group had significant improvement after the intervention ($p = .011$).</p> <p>In symbolic play, the children in the intervention group improved significantly ($p = .026$).</p> <p>When both groups had completed the program, combined analysis of both groups indicated that the intervention significantly improved language and communication ($p = .004$), vocalization ($p = .001$), and pointing ($p = .001$).</p> <p>A combined analysis indicated significant improvement in both reciprocal social interaction ($p = .008$) and integration of gaze and other behaviors during social overtures ($p = .002$), and analysis for the SPT indicated that the children had significant improvement in symbolic play ($p = .005$).</p>
Yoder & Lieberman (2010)	<p>Level I RCT</p> <p><i>N</i> = 36 children with a diagnosis on the autism spectrum ages 18–60 mo. All children used fewer than 10 words.</p>	<p><i>Intervention</i> PECS, delivered in a university clinic, 3x/wk in 20-min sessions.</p> <p><i>Control</i> RPMT using similar delivery schedule to PECS.</p>	<p>ESCS—Abridged, coded as number of picture exchanges at posttreatment assessment. The context of this assessment was judged to represent generality, i.e., a different context from training context, based on different examiner, setting, activities, and materials.</p>	<p>Baseline differences were observed in ADOS Social and MSEL Expressive Language scores, but these variables did not correlate highly with the outcome measure.</p> <p>A main effect for time was noted (pre vs. post): $F = 16.22, p < .001, d = 1.0$.</p>

(Continued)

Supplemental Table 2. Evidence for the Effectiveness of Social Communication Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
				<p>A Time \times Group effect was noted, $F = 5.5$, $p < .001$, related to nonsignificant between-groups differences at Time 1 and significant between-groups differences at Time 2, $t = 2.56$, $p = .018$, $d = 0.81$.</p> <p>Mean picture exchanges for PECS group at Time 2 = 3.84 ($SD = 4.5$); for RPMT group, 1.06 ($SD = 1.3$).</p>

Note. AAC = Alternative and Augmentative Communication; ABA = applied behavior analysis; ADOS = Autism Diagnostic Observation Schedule; ADOS-G = Autism Diagnostic Observation Schedule-General; ASD = autism spectrum disorder; CCT = controlled clinical trial; CI = confidence interval; DIR = Developmental, Individual differences, Relationship-based model; DQ = developmental quotient; ES = effect size; ESCS = Early Social Communication Scale; ID = intellectual disabilities; IRD = improvement rate difference; JA = joint attention; JE = joint engagement; M = mean; MSEL = Mullen Scales of Early Learning; OQAAQ = Overview Quality Assessment Questionnaire; PACT = Preschool Autism Communication Trial; PDD-NOS = pervasive developmental disorder—not otherwise specified; PECS = Picture Exchange Communication System; RCT = randomized controlled trial; RIT = reciprocal imitation training; RPMT = responsive education and prelinguistic milieu teaching; SD = standard deviation; SPT = Symbolic Play Test; TEACCH = Treatment and Education of Autistic and related Communication Handicapped Children.

^aOnly results for nontargeted outcomes (socialization, speech production, and challenging behaviors) are reported here because they are most pertinent to this review.

This table is a product of AOTA's Evidence-Based Practice Project and the *American Journal of Occupational Therapy*. Copyright © 2015 by the American Occupational Therapy Association. It may be freely reproduced for personal use in clinical or educational settings as long as the source is cited. All other uses require written permission from the American Occupational Therapy Association. To apply, visit www.copyright.com.

Suggested citation: Tanner, K., Hand, B. N., O'Toole, G., & Lane, A. E. (2015). Effectiveness of interventions to improve social participation, play, leisure, and restricted and repetitive behaviors in people with autism spectrum disorder: A systematic review (Suppl. Table 2). *American Journal of Occupational Therapy*, 69, 6905180010. <http://dx.doi.org/10.5014/ajot.2015.017806>

Supplemental Table 3. Evidence for the Effectiveness of Play and Leisure Interventions for People With ASD

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Barton & Wolery (2008)	Level I Systematic review N = 16 studies (1 Level I, 1 Level II, 14 Level IV). Participants were children with ASD or other disabilities ages 10 yr or younger.	<i>Intervention</i> Functional play with pretense behaviors included (1) placing a doll into a small bed, (2) putting an empty cup up to a doll's mouth, and (3) putting a spoon up to the child's own mouth. Object substitution behaviors were similarly operationalized across studies and typically included using a block or rod as a feeding utensil or vehicle. Assigning absent attributes was operationalized as taking on a nonliteral role (e.g., mother or doctor) or physical characteristic (e.g., the stove is hot, the dog is wet) across studies. Imagining absent objects was described as, e.g., eating imaginary ice cream or pantomiming. Sequences were inconsistently operationalized. All required ≥2 sequential behaviors of functional play with pretense or substitution. <i>Control</i> Varied across included studies.	Outcome measures varied across studies. Target behaviors included age-appropriate play skills, developmentally appropriate play skills, functional play, pretense, and object substitution.	Across studies, specific changes in pretense behaviors were examined rather than overall play levels or global engagement. The reports suggest that an increase in pretense behaviors is related to adult modeling or prompting in classrooms with materials typically found in early childhood classrooms, but few reports contained procedural fidelity data, maintenance data, or generalization data across settings, people, or toys. Dose and treatment fidelity issues are virtually ignored in intervention research on pretense. Future research could examine the amount of intervention (e.g., amount of time, no. of trials/day) necessary to produce changes in pretense.
Keen, Rodger, Doussin, & Braithwaite (2007)	Level III Pretest–posttest N = 16 children (14 boys, 2 girls; age range = 25–47 mo).	<i>Intervention</i> Stronger Families Project intervention, a 2-day parent workshop followed by 10 sessions of individual home-based early intervention; duration = 6 wk. <i>Control</i> Varied across included studies.	<ul style="list-style-type: none"> • Parenting Stress Index • Parenting Sense of Competence scale • Communication and Symbolic Behavior Scales Developmental Profile • Scales of Independent Behavior–Revised. 	Caregiver scores showed significant improvement from pre- to postintervention for the total score and symbolic component. However, the caregiver score for the speech component and all scores obtained from independent raters' assessments of child behavior were nonsignificant. Results reveal a trend toward greater improvement in parent-reported communication and symbolic behavior in children with lower levels of adaptive functioning before intervention.

(Continued)

Supplemental Table 3. Evidence for the Effectiveness of Play and Leisure Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Solomon, Necheles, Ferch, & Bruckman (2007)	Level III Pretest–posttest N = 68 children (51 boys, 17 girls; age range = 2–6 yr).	<i>Intervention</i> Parents received a detailed training manual, 1-day workshop, and monthly home visits from a consultant and were encouraged to engage their child in intervention activities a minimum of 15 hr/wk.	<ul style="list-style-type: none"> • The FEAS was used to measure changes in caregiver behaviors and in children's functional development. • Home consultants subjectively rated children's progress according to Greenspan's 6 functional developmental levels. • Families kept a record of the intensity of intervention via daily logs. 	45.5% of children made good to very good functional developmental progress over the study period (14 mo), based on FEAS scores. Children's functional developmental levels increased significantly. Trends that did not reach the level of statistical significance indicated that parents who spent more time interacting with their children made more progress on outcome measures.
Stagnitti, O'Connor, & Sheppard (2012)	Level III Pretest–posttest N = 19 (age range = 5–6 yr), 10 with autism.	<i>Intervention</i> The Learn to Play program is a child-led play-based intervention used to help children develop self-initiated play and pretend play skills. The intervention is provided in small groups of 4–7 children with 2 adults. Intervention took place for 1 hr 2x/wk.	<ul style="list-style-type: none"> • The Child-Initiated Pretend Play Assessment was used to measure presence and quality of pretend play. • The Preschool Language Scale, 4th Edition, was used to assess language skills. • The Penn Interactive Peer Play Scale was used to assess peer play competencies. 	The Learn to Play program was associated with significant increases in social interaction and language and decreases in social disconnection.

Note. ASD = autism spectrum disorder; FEAS = Functional Emotional Assessment Scale.

This table is a product of AOTA's Evidence-Based Practice Project and the *American Journal of Occupational Therapy*. Copyright © 2015 by the American Occupational Therapy Association. It may be freely reproduced for personal use in clinical or educational settings as long as the source is cited. All other uses require written permission from the American Occupational Therapy Association. To apply, visit www.copyright.com.

Suggested citation: Tanner, K., Hand, B. N., O'Toole, G., & Lane, A. E. (2015). Effectiveness of interventions to improve social participation, play, leisure, and restricted and repetitive behaviors in people with autism spectrum disorder: A systematic review (Suppl. Table 3). *American Journal of Occupational Therapy*, 69, 6905180010. <http://dx.doi.org/10.5014/ajot.2015.017806>

Supplemental Table 4. Evidence for the Effectiveness of Leisure Interventions for People With ASD

Author/Year	Level of Evidence/Study Design/ Participants/ Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Lang et al. (2011)	<p>Level I</p> <p>Systematic review</p> <p><i>N</i> = 15 studies (14 used single-subject design). Participants were 39 preschool or elementary school students with ASD (age range = 3–12 yr).</p> <p><i>Inclusion criteria:</i> (1) Contains ≥1 participant with autism, Asperger syndrome, or PDD–NOS ages 3–14 yr and (2) implements an intervention procedure or educational program at least in part during recess.</p>	<p><i>Intervention</i></p> <p>Interventions aimed to improve prosocial interactions (<i>n</i> = 12), to improve communication between the teacher or therapist and the student with ASD (<i>n</i> = 2), to decrease challenging behaviors during recess (<i>n</i> = 4), and to improve appropriate play behavior (<i>n</i> = 3). 6 studies used peer-mediated intervention.</p> <p>Other interventions included making changes to the environment, using vibrating pagers as a tactile prompt, using picture schedules, teachers leading students in activities designed to promote affection, and teachers prompting and reinforcing target behaviors.</p> <p><i>Control</i></p> <p>Varied by study</p>	<p>Outcome measures varied by study and included prosocial interactions between students with ASD and those without ASD (e.g., turn taking, greetings), interactions between students with ASD and teachers or therapists, instances of challenging behaviors during recess, and appropriate play behavior.</p>	<p>Studies found improvements in social initiation, turn taking, and improved group play when children had access to specialized playground equipment.</p> <p>Results suggest that students with ASD may need additional supports to benefit from educational and social opportunities on the playground.</p> <p>Studies highlight the benefit of (1) using peer-mediated intervention, (2) modifying playground equipment to promote specific skills, and (3) having adults facilitate specially designed games or activities that promote social interaction.</p>
Palmen, Didden, & Korzilius (2011)	<p>Level II</p> <p>Nonrandomized controlled trial</p> <p><i>N</i> = 12 high-functioning young adults (age range = 16–31 yr) with ASD.</p>	<p><i>Intervention</i></p> <p>The leisure program consisted of 16 group sessions over 6 mo lasting ~2.5 hr each. Program components included assessment, leisure engagement, leisure management, and generalization.</p> <p><i>Control</i></p> <p>No intervention</p>	<p>3 self-report questionnaires were developed for this study to measure (1) need for leisure support, (2) engagement in leisure activities, and (3) satisfaction in leisure lifestyle.</p>	<p>The control group had significant changes in pre- to postintervention scores, which indicated (1) decreases in need for leisure support, (2) more regular leisure engagement patterns, and (3) an increase in leisure satisfaction.</p>
Pan (2010)	<p>Level III</p> <p>Nonrandomized controlled crossover design</p> <p><i>N</i> = 16 boys with mild ASD or Asperger syndrome (age range = 6–9 yr).</p>	<p><i>Intervention</i></p> <p>Water Exercise Swimming Program (WESP) intervention consisted of 20 90-min sessions 2x/wk, which took place over 10 wk. Each session consisted of 4 components: (1) social and floor warm-up activities, (2) small-group instruction, (3) whole-group games, and (4) cool-down activities. Interventions were implemented in a 1:2 instructor-to-student ratio. Classroom teachers were blind to group membership.</p>	<ul style="list-style-type: none"> • Humphries Assessment of Aquatic Readiness to measure aquatic skill • Social behaviors, rated using the School Social Behavior Scale, which was filled out by the child's classroom teacher. 	<p>After receiving the intervention, both groups demonstrated significant improvements in social skills. At 10-wk follow-up, the improvements in social skills were maintained.</p> <p>Improvements were seen in aquatic skills for both groups after intervention.</p>

(Continued)

Supplemental Table 4. Evidence for the Effectiveness of Leisure Interventions for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/ Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Quirnbach, Lincoln, Feinberg-Gizzo, Ingersoll, & Andrews (2009)	Level I Randomized controlled trial N = 45 children (42 boys, 3 girls) with autism or an ASD (age range = 4–17 yr) with at least a 1st-grade reading level.	<i>Intervention</i> Children received 1 of 3 stories: (1) standard social story, (2) directive social story, or (3) control story.	<ul style="list-style-type: none"> Children's social skills were measured by rating 4 specific game play skills on a 3-point Likert scale: greeting behaviors, requesting to play a game, asking another person what they want to play, and accepting another's choice of game. Three independent, blind raters completed coding. 	Children who received either experimental condition showed significantly higher game-play skill scores than children who received the control story. Previous game-play experience (based on a questionnaire filled out by parents) was significantly correlated with total game-play scores. Participants demonstrated generalization of game-play skills to different games and maintained these learned skills 1 wk after the experimental conditions. No differences were found between the standard and directive social story groups. Participants with Verbal Comprehension Index scores <68 were unable to make significant improvements.

Note. ASD = autism spectrum disorder; PDD–NOS = pervasive developmental disorder—not otherwise specified.

This table is a product of AOTA's Evidence-Based Practice Project and the *American Journal of Occupational Therapy*. Copyright © 2015 by the American Occupational Therapy Association. It may be freely reproduced for personal use in clinical or educational settings as long as the source is cited. All other uses require written permission from the American Occupational Therapy Association. To apply, visit www.copyright.com.

Suggested citation: Tanner, K., Hand, B. N., O'Toole, G., & Lane, A. E. (2015). Effectiveness of interventions to improve social participation, play, leisure, and restricted and repetitive behaviors in people with autism spectrum disorder: A systematic review (Suppl. Table 4). *American Journal of Occupational Therapy*, 69, 6905180010. <http://dx.doi.org/10.5014/ajot.2015.017806>

Supplemental Table 5. Evidence for the Effectiveness of Interventions for Restricted and Repetitive Behaviors for People With ASD

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Bahrami, Movahedi, Marandi, & Abedi (2012)	Level I Randomized controlled trial N = 30 (4 girls, 26 boys; age range = 5–16 yr).	<i>Intervention</i> Kata training: 1 session/day, 4 days/wk, for 14 wk; sessions lasted 30–90 min. <i>Control</i> No exercise	Gilliam Autism Rating Scale–Second Edition (stereotyped behaviors)	Mean stereotypy severity scores significantly decreased from pre- to postintervention, and these results persisted at 14-wk follow up. No significant difference was found for the control group from pre- to postintervention.
Machalicek, O'Reilly, Beretvas, Sigafos, & Lancioni (2007)	Level I Systematic review N = 26 studies. Participants were school-children with ASD (age range = 3–21 yr) with challenging behaviors. Each study (1) included participants ages 3–21 yr with a diagnosis of ASD, (2) used a single-subject design, (3) was published in a peer-reviewed journal between 1995 and 2005, (4) applied an intervention in an effort to reduce challenging behavior, and (5) took place within the context of a classroom.	<i>Intervention</i> Classified into 1 of 4 categories: • <i>Antecedent manipulations</i> (n = 10 studies): Social Stories, video modeling, exercises, cue cards. • <i>Change in instructional context</i> (n = 5 studies): prompting strategies, embedded instruction, therapy balls as seats, rhythmic entrainment, allowing a student to choose between 2 types of reinforcement. • <i>Differential reinforcement</i> (n = 8 studies): functional communication training, PECS, differentially reinforced play behaviors, comparison of fixed reinforcement schedule of FR-1 to DRO. • <i>Self-management</i> (n = 3 studies): PECS to reduce aggression; self-management strategy to reduce stereotypies; photographic activity schedule to reduce aggressive, destructive noncompliant, stereotypical, and tantrum behaviors.	Gilliam Autism Rating Scale–Second Edition (stereotyped behaviors)	<i>Antecedent manipulations</i> : All studies reported positive results. <i>Change in instructional context</i> : 1 study had inconclusive results; all other studies showed decreases in challenging behaviors during intervention. <i>Differential reinforcement</i> : 1 study reported mixed results with DRO being much more effective than FR-1. Other studies reported positive results. <i>Self-management</i> : PECS reduced aggression, crying, and screaming. Self-management strategy had mixed results. Photographic activity schedule had mixed results.
Petrus et al. (2008)	Level I Systematic review N = 7 studies; 25 participants (age range = 5–15 yr). Level II, n = 2. Level IV, n = 2. Level V, n = 3. <i>Inclusion criteria</i> : (1) Intervention study using either exercise or physical therapy as the independent variable, (2) frequency of stereotypic behaviors as the dependent variable, (3)	<i>Intervention</i> Hydrotherapy (1 study) and jogging (6 studies) <i>Control</i> Varied by study	Time sampling, which measures the occurrence or nonoccurrence of a behavior at specific points over an observation period	Study quality scores ranged from 2 to 5 with M = 3.9 and mode = 5. A decrease in self-stimulatory behavior was noted in all studies. Effects of exercise on the reduction of self-stimulatory behaviors has been shown to be sustained ≤2 days after exercise. Higher intensity exercise was associated with more effective decreases in self-stimulation.

(Continued)

Supplemental Table 5. Evidence for the Effectiveness of Interventions for Restricted and Repetitive Behaviors for People With ASD (cont.)

Author/Year	Level of Evidence/Study Design/ Participants/Inclusion Criteria	Intervention and Control	Outcome Measures	Results
Southall & Gast (2011)	<p>children <19 yr old, and (4) children stated to have autism or an ASD.</p> <p>Level I Systematic review N = 16 studies; 35 participants (32 males, 3 females; age range = 3–25 yr). Inclusion criteria included (1) ≥1 participant with a pervasive developmental disorder, (2) intervention included self-management techniques, (3) studies were published in peer-reviewed journals, and (4) studies had a single-subject research design.</p>	<p><i>Intervention</i> Common components of most self-management interventions included (1) a timer to alert a student to self-assess, (2) a self-recording form, and (3) a desired reward. 4 studies addressed self-management to decrease RRBs. 5 studies attempted to increase social skills, and 4 studies focused on school or vocational skills.</p> <p><i>Control</i> Varied by study</p>	<p>7 studies used event recording procedures, 8 studies used interval recording, and 1 study used total duration of occurrence to measure behavior change.</p>	<p>Outcomes indicate that self-management procedures increased target behaviors for students with autism.</p>

Note. ASD = autism spectrum disorder; DRO = differential reinforcement of other behavior; FR-1 = fixed reinforcement schedule of 1; M = mean; PECS = Picture Exchange Communication System; RRBs = restricted and repetitive behaviors.

This table is a product of AOTA's Evidence-Based Practice Project and the *American Journal of Occupational Therapy*. Copyright © 2015 by the American Occupational Therapy Association. It may be freely reproduced for personal use in clinical or educational settings as long as the source is cited. All other uses require written permission from the American Occupational Therapy Association. To apply, visit www.copyright.com.

Suggested citation: Tanner, K., Hand, B. M., O'Toole, G., & Lane, A. E. (2015). Effectiveness of interventions to improve social participation, play, leisure, and restricted and repetitive behaviors in people with autism spectrum disorder: A systematic review (Suppl. Table 5). *American Journal of Occupational Therapy*, 69, 6905180010. <http://dx.doi.org/10.5014/ajot.2015.017806>

Supplemental Table 6. Risk-of-Bias Analysis for Included Studies

Author/Date	Selection Bias		Blinding of Participants and Personnel (Performance Bias)	Blinding of Outcome Assessment (Detection Bias)		Incomplete Outcome Data (Attrition Bias)			Selective Reporting (Reporting Bias)
	Random Sequence Generation	Allocation Concealment		Patient-Reported Outcomes	All-Cause Mortality	Short Term (2-6 Wk)	Long Term (>6 Wk)		
Social Skills									
Bellini, Peters, Benner, & Hopf (2007)	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	+
Castorina & Negri (2011)	-	-	+	-	n/a	n/a	n/a	n/a	+
Chan et al. (2009)	+	n/a	n/a	n/a	n/a	n/a	n/a	n/a	+
Cotugno (2009)	-	-	-	-	n/a	n/a	n/a	?	+
de Bruin & Verheij (2012)	+	-	-	-	n/a	n/a	n/a	+	+
DeRosier, Swick, Davis, McMillen, & Matthews (2011)	+	-	-	-	n/a	n/a	n/a	+	+
Farr, Yuill, & Raffle (2010)	-	-	-	-	n/a	n/a	n/a	+	+
Flynn & Healy (2012)	+	n/a	n/a	+	n/a	n/a	n/a	n/a	+
Gantman, Kapp, Orenski, & Laugeson (2012)	+	-	-	-	n/a	n/a	n/a	+	+
Herbrecht et al. (2009)	-	-	-	+	n/a	n/a	n/a	+	+
Hillier, Fish, Siegel, & Beversdorf (2011)	-	-	-	-	n/a	n/a	n/a	+	+
Hopkins et al. (2011)	?	-	-	+	n/a	n/a	n/a	+	+
Kandaloff, Didehbani, Krawczyk, Allen, & Chapman (2013)	?	n/a	n/a	+	n/a	n/a	n/a	+	+
Karkhaneh et al. (2010)	+	n/a	n/a	n/a	n/a	n/a	n/a	n/a	+
Kasari, Rotheram-Fuller, Locke, & Gulsrud (2012)	+	-	-	+	n/a	n/a	n/a	+	+
Koenig et al. (2010)	+	-	-	+	n/a	n/a	n/a	?	+
Kokina & Kern (2010)	+	n/a	n/a	n/a	n/a	n/a	n/a	n/a	+
Lerner & Mikami (2012)	+	-	+	+	n/a	n/a	n/a	+	+
Lopata et al. (2010)	+	-	-	-	n/a	n/a	n/a	+	+
Ramdoss et al. (2012)	+	n/a	n/a	n/a	n/a	n/a	n/a	n/a	+
Rao, Beidel, & Murray (2008)	+	n/a	n/a	n/a	n/a	n/a	n/a	n/a	+
Reichow, Steiner, & Volkmar (2013)	+	n/a	n/a	n/a	n/a	n/a	n/a	n/a	+
Reynhout & Carter (2011)	+	n/a	n/a	n/a	n/a	n/a	n/a	n/a	+
Schreiber (2011)	+	n/a	n/a	n/a	n/a	n/a	n/a	n/a	+
Shukla-Mehta, Miller, & Callahan, 2010	+	n/a	n/a	n/a	n/a	n/a	n/a	n/a	+
Sowa & Meulenbroek (2012)	+	n/a	n/a	n/a	n/a	n/a	n/a	n/a	+
Stichter, O'Connor, Herzog, Lierheimer, & McGhee (2012)	-	-	-	-	n/a	n/a	n/a	+	+
Test, Richter, Knight, & Spooner (2011)	+	n/a	n/a	n/a	n/a	n/a	n/a	n/a	+
Turner-Brown, Perry, Dichter, Bodfish, & Penn (2008)	-	-	+	+	n/a	n/a	n/a	n/a	+
Walker, Barry, & Bader (2010)	-	-	-	-	n/a	n/a	n/a	-	+
Wang & Spillane (2009)	+	n/a	n/a	n/a	n/a	n/a	n/a	n/a	+
Wang, Cui, & Parrila (2011)	+	n/a	n/a	n/a	n/a	n/a	n/a	n/a	+
White, Koenig, & Scathill (2007)	+	n/a	n/a	n/a	n/a	n/a	n/a	n/a	+
White, Koenig, & Scathill (2010)	-	-	-	-	n/a	n/a	n/a	+	+

(Continued)

Supplemental Table 6. Risk-of-Bias Analysis for Included Studies (cont.)

Author/Date	Selection Bias		Blinding of Participants and Personnel (Performance Bias)	Blinding of Outcome Assessment (Detection Bias)		Incomplete Outcome Data (Attrition Bias)			Selective Reporting (Reporting Bias)
	Random Sequence Generation	Allocation Concealment		Patient-Reported Outcomes	All-Cause Mortality	Short Term (2-6 Wk)	Long Term (>6 Wk)		
Zhang & Wheeler (2011)	+	n/a	n/a	n/a	n/a	n/a	n/a	+	
Social Communication									
Brunner & Seung (2009)	-	n/a	n/a	n/a	n/a	n/a	n/a	-	
Flippin, Reszka, & Watson (2010)	+	n/a	n/a	n/a	n/a	n/a	n/a	+	
Ganz, Davis, Lund, Goodwyn, & Simpson (2012)	-	n/a	n/a	n/a	n/a	n/a	n/a	-	
Gordon et al. (2011)	-	-	-	-	-	-	-	-	
Green et al. (2010)	+	-	-	-	-	-	-	+	
Howlin, Gordon, Pasco, Wade, & Charman (2007)	-	-	-	-	-	-	-	+	
Ingersoll (2010)	+	-	-	+	n/a	n/a	n/a	+	
Ingersoll (2012)	+	-	-	+	n/a	n/a	n/a	+	
Kaale, Smith, & Sponheim (2012)	+	+	+	+	n/a	n/a	n/a	+	
Kasari, Gulsrud, Wong, Kwon, & Locke (2010)	+	+	-	+	n/a	n/a	n/a	+	
Kasari, Papatrella, Freeman, & Jahromi (2008)	+	+	+	+	n/a	n/a	n/a	+	
Landa, Holman, O'Neill, & Stuart (2011)	+	-	+	+	n/a	n/a	n/a	+	
Lerna, Esposito, Conson, Russo, & Massagli (2012)	-	-	+	+	n/a	n/a	n/a	+	
Oosterling et al. (2010)	-	-	-	+	n/a	n/a	n/a	+	
Ospina et al. (2008)	+	n/a	n/a	n/a	n/a	n/a	n/a	+	
Seida et al. (2009)	+	n/a	n/a	n/a	n/a	n/a	n/a	+	
Vismara, Colombi, & Rogers (2009)	-	-	-	-	-	-	-	-	
Wong & Kwan (2010)	+	+	+	+	+	+	+	+	
Yoder & Lieberman (2010)	+	-	+	+	n/a	n/a	n/a	-	
Play									
Barton & Wolery (2008)	+	n/a	n/a	n/a	n/a	n/a	n/a	+	
Keen, Rodger, Doussin, & Braithwaite (2007)	-	-	-	?	+	+	+	+	
Solomon, Necheles, Ferch, & Bruckman (2007)	-	-	-	-	+	+	+	+	
Stagnitti, O'Connor, & Sheppard (2012)	-	-	-	+	+	+	+	+	
Leisure									
Lang et al. (2011)	+	n/a	n/a	n/a	n/a	n/a	n/a	+	
Palmen, Didden, & Korzilius (2011)	-	-	-	-	+	+	+	+	
Pan (2010)	?	?	-	-	+	+	+	+	

(Continued)

Supplemental Table 6. Risk-of-Bias Analysis for Included Studies (cont.)

Author/Date	Selection Bias		Blinding of Participants and Personnel (Performance Bias)	Blinding of Outcome Assessment (Detection Bias)		Incomplete Outcome Data (Attrition Bias)		
	Random Sequence Generation	Allocation Concealment		Patient-Reported Outcomes	All-Cause Mortality	Short Term (2-6 Wk)	Long Term (>6 Wk)	Selective Reporting (Reporting Bias)
Quirnbach, Lincoln, Feinberg-Gizzo, Ingersoll, & Andrews (2009)	+	+	-	+	+	n/a	n/a	+
Restricted and Repetitive Behaviors								
Bahrami, Movahedi, Marandi, & Abedi (2012)	+	+	-	+	+	+	+	+
Machalicek, O'Reilly, Beretvas, Sigafos, & Lancioni (2007)	+	n/a	n/a	n/a	n/a	n/a	n/a	+
Petrus et al. (2008)	+	n/a	n/a	n/a	n/a	n/a	n/a	+
Southall & Gast (2011)	+	n/a	n/a	n/a	n/a	n/a	n/a	+

Note. + = low risk of bias; ? = unclear risk of bias; - = high risk of bias; n/a = not applicable.

This table is a product of AOTA's Evidence-Based Practice Project and the *American Journal of Occupational Therapy*. Copyright © 2015 by the American Occupational Therapy Association. It may be freely reproduced for personal use in clinical or educational settings as long as the source is cited. All other uses require written permission from the American Occupational Therapy Association. To apply, visit www.copyright.com.

Suggested citation: Tanner, K., Hand, B. N., O'Toole, G., & Lane, A. E. (2015). Effectiveness of interventions to improve social participation, play, leisure, and restricted and repetitive behaviors in people with autism spectrum disorder: A systematic review (Suppl. Table 6). *American Journal of Occupational Therapy*, 69, 6905180010. <http://dx.doi.org/10.5014/ajpt.2015.017806>