The purposes of this organization shall be to advance the education and welfare of persons with autism and developmental disabilities, research in the education of persons with autism and developmental disabilities, competency of educators in this field, public understanding of autism and developmental disabilities, and legislation needed to help accomplish these goals. The Division shall encourage and promote professional growth, research, and the dissemination and utilization of research findings.

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September 2016

Defining success for students with autism spectrum disorder: Social academic behavior in secondary general education settings. Elizabeth L. McKenney, Catherine Stachniak, Jordan Albright, Jeremy D. Jewell, and Julie M. Dorencz, Department of Psychology, Southern Illinois University Edwardsville, Campus Box 1121, Edwardsville, IL 62026.

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Five essential features of quality educational programs for students with moderate and severe intellectual disability: A guide for administrators in special education. Robert C. Pennington, Ginevra Courtade, Melinda Jones Ault, and Monica Delano, Department of Special Education, College of Education and Human Development, University of Louisville, Louisville, KY 40292.

An exploration of friendships and socialization for adolescents with autism engaged in massive multiplayer role-playing games (MMORPG). Jennifer Gallup, Christine Duff, Barbara Serianni, and Adam Gallup, College of Education, Idaho State University, 921 S 8th Ave., Pocatello, ID 83201.


Teaching writing in response to text to students with developmental disabilities who participate in alternative assessments. Angel Lee, Diane M. Browder, Katherine Hawley, Claudia Flowers and Shawnee Wakeman, Attainment Company, 3422 Fairfax Woods Dr., Matthews, NC 28105.

Culture in inclusive schools: Parental perspectives on trusting family partnerships. Grace Francis, Martha Blue-Banning, Ann P. Turnbull, Cokethea Hill, Shana J. Haines, and Judith M.S. Gross, George Mason University, Finley Building 205B, 4400 University Drive, MS 1F2, Fairfax, VA 22030.

Effects of iPod technology as communication devices on peer social interactions across environments. G. Richmond Mancil, Elizabeth R. Lorah, and Peggy Schaefer Whitby, Louisiana Tech University, 1910 West California Avenue, Ruston, LA 71270.

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Effectiveness and Acceptability of Parent-Implemented Behavior Interventions for Children with Autism in Three African American Families

Rachel E. Robertson
University of Pittsburgh

Abstract: No studies of parent-implemented behavior interventions for children with autism spectrum disorders (ASD) have purposefully examined their effectiveness and acceptability with African American families. The present study used a multiple baseline across participants design to evaluate the effectiveness of parent-implemented differential reinforcement plus visual support to increase appropriate alternatives to problem behavior in three children with ASD from African American families. Parents also rated the social validity of the intervention and were qualitatively interviewed regarding their perceptions of its effectiveness and acceptability. Results indicated the intervention was effective for 2 of 3 dyads, though levels of treatment integrity ranged greatly across participants and over time. In general, all dyads rated the intervention as acceptable and effective. Implications of this study for effectiveness and acceptability of behavior interventions in groups less represented in autism research are discussed.

Children diagnosed with autism spectrum disorder (ASD) are at high risk of developing challenging behaviors such as aggression and self-injury in comparison to both typical children and children with other developmental disabilities (Baker et al., 2003; Chadwick, Kusel, & Cuddy, 2008). These behaviors are often severe and persistent (Emerson et al., 2001; Green, O’Reilly, Itchon, and Sigafoos, 2005) and associated with poor outcomes, such as exclusion from mainstream environments (Allen, Lowe, Moore, & Brophy, 2007; Yianni-Coudurier et al., 2008) and decreased adaptive skills (Richman & Lindauer, 2005) for children, and increased stress (Lecavalier, Leone, & Wiltz, 2006) and marital difficulty (Brobst, Clopton, & Hendrick, 2009) for parents.

Fortunately, decades of research in areas related to applied behavior analysis have led to an evidence base of effective interventions to improve adaptive behavior and decrease problematic behavior in children with ASD (Odom, Collet-Klingenberg, Rogers, & Hattton, 2010; Rogers & Vismara, 2008). In particular, parent involvement, training, and implementation of interventions has been identified as both a means to improve the effectiveness, generalizability, maintenance, and cost of interventions for children with ASD (Matson, Mahan, & Matson, 2009) and as an evidence-based practice itself (Odom et al., 2010). Specifically, teaching parents to implement interventions can increase intervention dosage by allowing parents to integrate intervention strategies into ongoing daily activities for months or years past the point of training, and during activities and in settings less accessible to another interventionist (Brookman-Frazee, Vismara, Drahota, Stahmer, & Openden, 2009).

Parent participants involved in studies of parent-implemented interventions are in the...
unique role of being both the recipients of intervention, as researchers must train parents to implement the intervention, as well as the deliverers of the intervention to their child. Because of this dual role, parents themselves are extremely important factors in the success of parent-implimented interventions (Brookman-Frazee et al., 2009). Further, specific parent characteristics have been associated with increased or decreased effectiveness of parent training. For example, Lundahl, Risser, and Lovejoy (2006) conducted a meta-analysis of parent training interventions for parents of children with behavior problems and found these interventions were least effective for economically disadvantaged parents. Unfortunately, the demographic characteristics of parent participants in studies of parent-implimented behavior interventions for children with ASD are not fully known, as few studies appear to report race or SES of parent or child participants (Conroy, Dunlap, Clarke, & Alter, 2005; McLaughlin, Denney, Snyder, & Welsh, 2012). Nevertheless, there is general agreement among many researchers that the evidence bases for both autism intervention and parent training have been developed primarily using participants from middle class Caucasian families (Coard, Wallace, Stevenson, & Brotman, 2004; Dyches, Wilder, Sudweeks, Obiakor, & Algozzine, 2004; Forehand & Kotchick, 1996; Horovitz, Matson, Rieske, Kozlowski, & Sipes, 2011), with very few studies purposefully testing the effectiveness of parent-implimented behavior interventions for children with ASD in families who are not Caucasian (Cheremshynski, Lucyshyn, & Olson, 2012) or who are of lower SES.

While it is not yet clear what impact culture, race, SES, or other demographic factors may have on the effectiveness and acceptability of parent-implimented behavior interventions for children with ASD, there are reasons to believe such factors are important. Race and culture bring a shared identity, history, and set of values that may shape which skills and competencies parents deem most important for children to learn to ensure their survival and success (Forehand & Kotchick, 1996). Race and culture have been shown to affect which behavior management practices a parent may choose to employ (LeCuyer, Christensen, Kearney, & Kitzman, 2011) and find acceptable (Njardvic & Kelley, 2008). Additionally, lower SES is often associated with a variety of hardships, such as poverty, unemployment, homelessness, single parenthood, community violence, and mental health issues (Bradley & Corwyn, 2002), many of which have been found to have negative influences on parenting practices (Klebanov, Brooks-Gunn, & Duncan, 1994) and possibly decrease the treatment integrity and maintenance of interventions (Schertz & Odom, 2007). Furthermore, it is likely that race and SES interact to impact the experience of parenting a child with ASD. For example, Carr and Lord (2012) found perceived negative impact of having a child with ASD was reduced in African American mothers with lower educational levels when compared to African American mothers with higher educational levels and Caucasian mothers of all educational levels. Finally, there is mixed evidence on whether behavior interventions yield different effects for Caucasian and non-Caucasian groups. Kolko, Cheng, Campo, and Kelleher (2011) compared two treatments for typical children with behavior problems and found that an on-site, nurse-administered intervention was more effective for Caucasian families, whereas enhanced usual care was more effective for non-Caucasian families. Alternatively, McCabe and Yeh (2009) found that Mexican American families of children with conduct problems benefitted similarly regardless of whether they received Parent-Child Interaction Therapy (PCIT) or a culturally adapted version of PCIT. Taken together, there is evidence that race and SES may influence parenting styles and approaches to behavior management; however it is not clear whether or how such differences may influence the effectiveness of parent-implimented interventions in children with ASD.

African American families in particular appear to have been infrequent participants in autism research (Hilton et al., 2010), and more specifically in studies of parent-implimented behavior interventions for children with ASD (e.g., Baker-Ericzen et al., 2007). Certainly little to no research in parent training has been purposefully directed towards African American families of children with ASD. For example, a search of the PsychINFO database for “parent training” and “autism”
revealed 315 results whereas a search for “parent training” “autism” and “African American” or “black” produced one result (Farber & Maharaj, 2005), and this study did not report including parents of children with ASD. There are a variety of reasons why African Americans may be less likely than other groups to participate in autism intervention research, such as the historic exploitation of African Americans in medical research (Skloot, 2010), the delay African Americans may experience in getting an autism diagnosis for their child (Mandell, Ittenbach, Levy, & Pinto-Martin, 2007), perceived power imbalances between researchers and research participants (Hilton et al., 2010), and traditional recruitment strategies being ineffective in connecting with potential African American participants (Spruill, 2010). The lack of African American participants in parent-implemented behavior interventions for children with ASD is concerning given that African American children and Caucasian children may be equally likely to develop ASD (Dyches et al., 2004.) and preliminary evidence indicating that African American children with ASD may be more likely to develop challenging behavior (Horovitz et al., 2011).

Because research-based, parent-implemented interventions are likely to reflect the values, preferences, and results of families who have been involved in developing this research base to date, parent-implemented behavior management strategies for children with ASD may be less useful, acceptable, or effective for African American families and may need to be adapted to better suit their values and needs.

The purpose of this study was to examine the effectiveness and acceptability of parent-implemented behavior interventions for children with ASD in African American families in order to study the effectiveness and acceptability of behavior interventions with families less represented in autism research. Research questions were (a) would a multiple baseline across participants design show behavior interventions to be effective across purposefully sampled African American families with children with ASD, (b) would parents maintain results and procedures over time, and (c) would parents perceive the intervention they received as acceptable and effective?

Method

Participants

Four families responded to recruitment efforts. Because one child did not meet the inclusion criterion of displaying difficult behavior at home, three parent-child dyads participated in the present study. Evan was a 7-year-old boy diagnosed with Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS). He communicated in complete sentences, followed 1- and 2-step directions, and attended a public 1st grade general education classroom for the full day. A masters-level behavior consultant regularly provided him and his mother with home-based behavior support through a state-funded program. His mother contacted the investigator due to Evan’s severe tantrums, mild aggression, and mild self-injurious behavior at home. Aggressive behaviors were often directed towards one of his four siblings. Evan’s mother, Viola, was 35 years old, married, possessed a master’s degree, and was a stay-at-home-mother at the time of the study. Evan’s father frequently traveled for work. Viola reported their household income to be above $80,000.

Prince was a 16-year-old boy diagnosed with autistic disorder. He communicated in brief sentences and phrases, followed 1- and 2-step directions, occasionally showed mild self-injury, and attended an all-day self-contained special education class at a public junior high school. His mother contacted the investigator due to concern about his prompt dependence and off-task behavior at home after school. Prince’s mother, Latisha, was a 37-year-old full-time student working towards a bachelor’s degree. She had another son who was 14 years old who also resided with her and Prince. She was divorced from Prince’s father and remarried; however her husband was incarcerated out of state. She had also been recently incarcerated and resided in a supportive housing program for homeless women. Latisha did not return a form requesting demographic information so her income level is unknown, but she did verbally report having little money past what was needed to cover necessities. She did not possess a vehicle and relied on public transportation.

Clarice was a 17-year-old female, diagnosed
with autistic disorder, who communicated in one to three word phrases, followed 1-step directions, and attended a self-contained special education school for children with significant disabilities. She had a long history of severe aggressive, self-injurious, and destructive behaviors; however none had been observed for the previous 6 months at the start of the study, reportedly due to adding Risperdal to her medications. One year prior to the beginning of the study, Clarice had been placed in a group residence for women with developmental disabilities. Although Clarice no longer resided with her mother, she went to visit her mother, accompanied by a group residence staff member, every Friday for dinner and leisure time. Her mother, Talia, was concerned about Clarice’s rapid eating during these dinners and residence staff indicated she was considered a choke risk due to the rate at which she ate as well as the size of the bites of food she put into her mouth. Talia, Clarice’s mother, was in her late 40s, unemployed, and did not reside with Clarice’s father, who lived in a nearby town. Talia did not return a form requesting demographic information. She resided in public housing and often described having little money past what was needed to cover necessities. Talia did not have a car and relied on public transportation, which was sparse in her area.

**Setting and Materials**

The study was completed in each participant dyad’s home and took place during a naturally-occurring routine associated with difficult child behavior. Sessions were conducted approximately once per week. For Evan, the target routine was playing video games with his parents and siblings, which took place in the living room each day and lasted 1 hour. For Prince, the target routine was his daily after school routine, during which his mother expected him to change his clothes, put his school clothes away, do his homework, and get a snack. Prince’s after school routine took place in his bedroom and the kitchen and lasted approximately 20 min each day. For Clarice, the target routine was eating dinner at her mother’s house on Friday evenings. Dinner took place in the kitchen and lasted approximately 1 hour; however the first course of dinner (salad or another vegetable dish) was the focus of baseline and intervention sessions and lasted approximately 10 min.

The investigator brought a video camera and tripod to each session to record the dyad in their target routine for later coding. Additional materials were developed for each dyad’s intervention phase; these materials are described in the section on intervention procedures.

Additionally, parents completed one rating scale during the study. The Social Validity and Maintenance Rating Scale (see Table 1) was a researcher-designed questionnaire used to assess parent perceptions of the effectiveness and acceptability of the intervention they received.

**Dependent Variables**

Dependent variables were individualized to each dyad and focused on adaptive alternatives to problem behaviors to target for increase in each child. Evan’s dependent variable was “safe behavior” as indicated by keeping his hands, mouth, and feet to himself, absence of mild self-injury, such as dropping to the floor and banging body parts on the floor, and absence of crying and screaming. Prince’s dependent variable was independent completion of the steps of his after school routine. A step was considered completed independently if Prince successfully completed the required behavior without verbal, gestural, or physical prompting from his mother. Clarice’s dependent variable was interresponse time (IRT) between bites of food. A bite was defined as Clarice putting food into her mouth. She typically used a fork or spoon but occasionally used her fingers to take bites. Any means by which she placed food in her mouth was considered a bite. Additionally, the time between taking a bite of food and a sip of a drink was also included in her IRT measure as Clarice’s mother wanted her to chew and swallow food before taking a drink. A sip of drink was defined as Clarice putting drink into her mouth.

**Data Collection and Interobserver Agreement**

Data were collected by digitally videotaping each session for later coding. Evan’s depen-
dent variable of safe behavior was measured using 10-s whole interval recording, such that the 1-hour observation period was broken into 360 10-s intervals. If Evan displayed safe behavior throughout the entirety of a 10-s interval, that interval was counted as safe. Intervals with safe behavior were divided by total number of intervals for each session, which produced a percentage of intervals with safe behavior per session.

Prince’s dependent variable of independent completion of steps of his after-school routine was measured per session by coding each of his 11 after-school routine steps as prompted or independent and as complete or incomplete. The number of steps completed independently was divided by total number of steps in the routine to produce the percentage of steps completed independently during each session. If a step was not included in the after school routine that day (e.g., no homework was given), that step was removed from the calculation for that session.

Clarice’s dependent variable of IRT between bites was measured by continuous event recording of each bite per session using ProCoder for Digital Video (Tapp, 2003). Number of seconds between each bite was then calculated and averaged to produce the average IRT between bites per session.

A second observer independently coded data for 38% of Evan’s sessions, 32% of Prince’s sessions, and 33% of Clarice’s sessions for a total of 34% of all sessions. Each interobserver agreement (IOA) session was randomly selected from every three chronologically occurring data collection sessions in each condition. IOA was calculated for each dependent variable using exact agreement, such that first and second observers’ coding streams were aligned to assess point-by-point agreements and disagreements. For Clarice, IOA was calculated using exact agreement for the onset and offset of each IRT using a 2 s coding window. Number of agreements was then divided by total number of agreements plus disagreements to produce a percentage of IOA for each observation. IOA was 93% across participants and behaviors.

**Experimental Design**

The effectiveness of parent-implemented behavior interventions was evaluated using a multiple baseline across participants design. Baseline data were collected on dependent variables in the naturally-occurring difficult routine reported by parents. Intervention data were collected in the same routine while parents were taught to use the intervention, and maintenance data were collected in the same routine after parents had demonstrated adequate implementation of the intervention and investigator coaching had been withdrawn. Visits for data collection occurred weekly during all conditions although some visits were cancelled by parents due to self or child illness or other family issues. Cancelled visits remain on the X-axis of the graph to accurately capture the passage of time across participants during the study. Additionally Evan’s family was visited every other week after 7 weeks with no problem behavior.

**Procedure**

**Baseline.** Baseline sessions were conducted weekly in the difficult routine reported by parents. For Evan, this routine was playing video games with his family, during which he frequently engaged in tantrums and mild self-injury when he lost a game to a family member. The one change made to this routine for the purpose of the study was that all video games included direct competition (e.g., competitive racing games) as opposed to games without direct competition (e.g., role playing games). This change was made to control for competitive versus non-competitive games being a source of variability in the dependent variable. Video games typically began at 4:30 p.m. each day and lasted 1 hour. During baseline, Evan’s mother was not provided with any instruction on how to respond to his tantrums or his appropriate behavior and was free to interact with him as she normally would. For Prince, the baseline routine was his daily after school routine at home, during which his mother wanted him to change clothes, put clothes away, do homework, and eat a snack. Prince typically arrived home from school at 3 p.m. each day. The routine began immediately and lasted approximately 20 min. During
baseline, Prince’s mother was not given any instructions on how to interact with Prince during his after school routine and was free to respond to him as she normally would. For Clarice, the baseline routine was eating dinner with her mother at her mother’s house, which occurred every Friday, and during which she engaged in rapid eating. The focus of baseline and intervention data collection was the first course of Clarice’s dinner which was a salad or other vegetable course and lasted approximately 10 min. During baseline, Clarice’s mother was not instructed on how to interact with Clarice and was free to respond to Clarice as she normally would.

**Intervention.** While intervention procedures were individualized to each dyad, all interventions used a combination of differential reinforcement plus visual support.

**Evan.** Evan’s intervention procedure was developed by his masters-level behavior specialist. The strategy consisted of visual supports, differential reinforcement, and response cost. The primary visual support was an 8” by 11” laminated red paper with the words “Playing Video Games” on the top that visually depicted the following contingency: If Evan kept safe hands, feet, mouth, and body for the duration of each video game, he was allowed to move on to playing the next video game. A game was defined as playing a round of a specific game (e.g., Mario Kart) until the competition involved in the game was complete, and it was clear who had won and how all the family members playing had placed. This procedure continued until Evan reached 10 video games, at which point he earned a peanut butter cup and could start the 10 game-sequence over again. If, however, he did not maintain safe behavior during any one of the 10 games, video games ended immediately, and Evan would only be allowed to play board games. This consequence was indicated on the visual as well. At this point, a secondary visual would be presented showing that if Evan played three board games with safe behavior, he could return to playing video games.

**Prince.** Prince’s intervention consisted of visual support, 5 s of wait time for each step of his after school routine, differential reinforcement in the form of praise for independently completing steps, and most-to-least prompting (without verbal prompting) for error correction. Prince’s visual support was an 8” by 11” white piece of paper with a checklist of the steps of his after-school routine. For the purposes of his checklist, the 11 steps of his routine on which data were collected were consolidated into eight simply-phrased steps (e.g., “hang up coat”). Each day when Prince arrived home from school, a copy of this checklist was on the dining room table accompanied by a pen or pencil. Prince read the checklist, completed each step, and crossed steps off of the checklist after they were completed. Because baseline observations suggested that Latisha’s verbal statements (positive and negative) may have functioned as reinforcers for Prince’s behavior, independent completion of each step was followed by verbal praise from Latisha. To avoid reinforcing Prince’s errors in completing the routine, Latisha was to refrain from verbally prompting during error correction and instead used a system of most-to-least prompting in which she physically-to-gesturally guided Prince back to his checklist to complete any step he skipped or did not fully complete on his own. When Prince finished and crossed off all steps of the after-school routine, the words “Finished!” with a smiley face remained at the bottom of the page and Prince was allowed to move on to free time. At session 19 (the third maintenance session) Latisha had written a more consolidated checklist (4 steps) on a dry erase board and hung it on Prince’s bedroom door. This dry erase board was used as Prince’s visual support for the remainder of the study.

**Clarice.** Clarice’s intervention consisted of visual support plus spaced-responding differential reinforcement of low rates of behavior (DRL) during the first course of her weekly dinner with her mother. Her visual support was a pink GymBosSTM interval timer which depicted a countdown of the number of seconds until Clarice could take a bite of food. When the countdown was completed, the timer beeped twice and began the interval countdown again. Because Clarice’s average baseline IRT was 5 s with a range of 0.5 to 23 s, the timer was initially set for 8 s intervals as this interval was estimated to be feasible, and the interval could be made longer once this interval was mastered. Because Clarice was observed during baseline to frequently comply...
with her mother’s verbal requests to slow her eating, and because her mother and group home staff were concerned that physically blocking Clarice from taking a bite might trigger her aggressive, destructive, or self-injurious behavior, her mother verbally prompted her to wait for the “beep” to take a bite and to put her fork down between “beeps.” Waiting during the 8 s interval was reinforced by allowing Clarice to take a bite of food. At session 28 the prompting level was increased to mild physical blocking accomplished by Talia holding and rubbing Clarice’s eating hand between “beeps” and letting her hand go once the timer sounded.

**Maintenance.** Once parents demonstrated adequate treatment integrity (TI; defined in parent training section) they were told they could manage behavior however they chose, and the maintenance phase began. Procedures for maintenance sessions were the same as those used during intervention sessions except no training, instructions, or feedback were provided to the parent. Ongoing maintenance data were collected on dependent variables for Evan and Viola and Prince and Latisha for a period of 15 and 13 weeks, respectively. One maintenance session was collected for Clarice and Talia.

**Parent training.** Latisha and Talia were individually trained to implement procedures using a combination of instructions, modeling, role play, and feedback. Viola’s intervention was developed by Evan’s behavior specialist, who taught Viola how to implement the intervention by showing her the visual supports and verbally instructing her on their use. During training for Latisha and Talia, the investigator introduced the visual supports and instructed parents on reinforcement and error correction procedures. The investigator then modeled the use of the procedures with the parent role playing as the child. Investigator and parent then switched roles and the parent role-played using the procedures, as the investigator role-played as the child. The investigator gave behavior-specific praise for correct implementation by parents and gave corrective feedback when the parent made an error. After this training session, the child entered, and the parent implemented the intervention with their child in the target routine. During this time, the investigator continued to give prompts and behavior-specific praise to the parents for correct implementation and corrective feedback for parent errors. Training sessions took place for the first three intervention sessions, after which pre-session instructions, modeling, role play, and feedback ended. Investigator coaching using prompting, praise, and corrective feedback during intervention sessions continued until parents implemented procedures at 80% TI or greater for at least two of three consecutive sessions. At this point (week 11 for Viola and week 16 for Latisha) all prompting and feedback were withdrawn, and the parent entered the maintenance phase, during which they were told they could manage behavior however they chose. Talia did not reach adequate implementation; however one maintenance session was conducted to examine her implementation in absence of investigator support.

**Treatment integrity.** Treatment Integrity for parent implementation of intervention procedures was calculated for all baseline and intervention sessions for all participants. Baseline TI was scored to assess the degree to which parents were implementing intervention procedures during baseline compared to intervention. After each intervention was implemented and TI scoring procedures were established, baseline videos were reviewed and baseline parent behavior was scored with the same tool used to assess parent TI during intervention.

Correct implementation of procedures for Viola was broken into three categories: pre-game use of the visual support (50% of TI), implementation of contingencies in response to each game (25% of TI), and use of visual in response to each game (25% of TI). For pre-game use of the visual support, Viola was to (a) have the visual support out and available in the video game area, and (b) review the rules outlined in the visual support with Evan prior to the start of video games. These two items were scored as yes (1) or no (0) and were aggregated for a pre-game visual support score per session of 0% (neither items were implemented), 50% (one item was implemented), or 100% (both items were implemented). This aggregate score counted for 50% of the session’s total TI. For implementation of contingencies, if Evan had safe behavior throughout a game Viola was to state...
that Evan had done so and could move on to the next game; if Evan had problem behavior, Viola was to direct Evan away from video games to play board games instead. For use of visual in response to each game, Viola was to move the corresponding pieces on the visual to indicate that Evan had safe behavior and could move on to the next game, or that he had problem behavior and had to leave video games for board games. These criteria were each scored as full implementation (1.0), partial implementation (0.5), or no implementation (0). Therefore, for each individual game, perfect TI would earn a score of 1 for implementation of contingencies and 1 for use of visual, totaling 2 points per game. TI was then calculated by adding the total score for implementation of contingencies and use of visual across all games played during the session and dividing by the total number of points that could be earned for perfect implementation. The resulting percentage was then averaged with the percentage score for pregame use of visual described above to produce the total TI percentage for each session.

For Latisha, correct implementation of procedures was defined as (a) having the visual support out and available for Prince, (b) waiting 5 s for Prince to independently check his schedule and begin the next step of the routine, (c) if Prince independently completed the step, praising Prince, or (d) if Prince did not independently complete the step, nonverbally directing Prince to his checklist. For each session, the criterion of having the visual available was counted once as yes (1) or no (0), while the remaining two criteria (waiting to see if Prince would execute the target behavior independently and either praising or correcting his response) were calculated for each of eight steps outlined on Prince’s checklist. These criteria were also scored as yes (1) or no (0) for each step. These procedures resulted in a total of 17 criteria per session (1 criterion for presence of visual and two criteria per each of 8 steps). The number of criteria met was divided by total number of criteria (17) to produce a percentage of TI per session.

For Talia, TI was defined as (a) having the visual timer out and running, and (b) preventing Clarice from taking a bite until the 8 s interval lapsed. The criterion of having the visual timer out and running was counted once per session as yes (1) or no (0) and made up 25% of each session’s TI. The remaining 75% of TI came from the criterion of only allowing bites after 8 s had lapsed and was counted as the percentage of bites meeting this criterion out of the total number of bites. The resulting percentage for using the visual timer was then averaged with three times the resulting percentage for preventing bites until 8 s had lapsed to produce the total percentage TI for the session.

Results

Figure 1 presents the effects of visual support plus reinforcement on child adaptive behavior and parent TI during baseline, intervention, and maintenance phases. Visual analysis of the data suggests the intervention was effective for 2 of 3 participant dyads.

Evan and Viola

Safe behavior occurred for 84%, 100%, and then 70% of intervals during Evan’s three baseline sessions (M = 84.7%). Upon implementation of the intervention, Evan’s safe behavior immediately increased to 100% of intervals for the remainder of the intervention phase. After investigator coaching was withdrawn and the maintenance phase began, Evan’s safe behavior remained at 100% for the duration of the 15-week maintenance period. During baseline, Viola’s TI was low and variable, averaging 11.3% (range 0% – 30%), with TI during her final baseline session at 0%. After intervention, Viola’s TI immediately increased to 71% and continued in a variable, accelerating trend, with TI during her final intervention session at 89% (M = 73.4%, range 58% – 89%). After the withdrawal of all investigator support, Viola’s TI steadily decreased over the first four maintenance sessions from 75% to 31%. TI then increased briefly to 59% and 63% before decreasing to 6% and 2% during final maintenance sessions (M = 41.5%, range 2% – 75%).

Prince and Latisha

During baseline, the percentage of steps of Prince’s after-school routine completed inde-
independently were low in level and somewhat variable with a slight increase in trend between sessions 3 and 8 ($M = 39\%$, range 27 – 55\%). Upon implementation of the intervention, Prince’s independent completion of steps increased immediately to 82%. Independent completion of steps then decreased slightly to 80% before increasing to 93% in session 12 and 100% in sessions 14 and 15 to complete the intervention phase ($M = 90.4\%$, range 80 – 100\%). After all investigator coaching was withdrawn and the maintenance phase began, Prince’s independent completion of steps became more variable but remained above baseline levels, with an initial decrease to 73% in session 16 before steadily
increasing over the remainder of the maintenance phase (M = 84.5, range 64 – 100%). Prince’s independent completion of steps during his final 3 maintenance sessions was elevated and stable in level with a range from 86% to 91% (M = 88.7%). During baseline, Latisha’s TI had a variable, slightly increasing trend and averaged 35.3% (range 24 – 53%). After intervention, TI immediately increased to 88%, then decreased to 73% before increasing to 93%, 100%, and 94% in the final three intervention sessions (M = 89.6%, range 73 – 100%). Once investigator support was withdrawn, TI immediately decreased to 65%, increased briefly to 71%, and then decreased gradually while remaining at a similar level for the remainder of the maintenance phase, ending at 47% (M = 54.3%, range 45 – 71%).

Clarice’s average IRT was somewhat variable with a slightly increasing trend during baseline and ranged from 3.3 s to 5.8 s, with her final baseline session at 5.8 s (M = 4.85). After implementation of intervention, average IRT remained at a level, trend, and variability similar to baseline with a range of 4.1 s to 6 s (M = 4.7). Due to low TI with the initial intervention and the lack of an effect on the dependent variable, an increase from verbal to physical prompting was introduced during session 28. During the three sessions with physical prompting, there was an increasing trend in average IRT, with an average of 5.7 s, 5.9 s, and 8.1 s, respectively (M = 6.6 s). Because IRT criterion (8 s) was reached during session 30 and part of the goal of the study was to assess parent maintenance without coaching, investigator coaching was withdrawn at this point and the maintenance phase began. Maintenance data were collected during one final session and indicated that average IRT had decreased to a level similar to previous baseline and intervention levels at 5.4 s. During baseline, Talia’s TI was low in level with little variability and a relatively flat trend, averaging 9.6% (range 4.5 – 13.5%). After intervention, TI increased from 8.5% on the last baseline session to 44.5% during the first intervention session. TI then remained relatively stable at this level with a slightly decreasing trend until session 28 when physical prompting was begun, after which TI increased slightly to 43.8%, 42.3%, and 48.3% during the last three intervention sessions (M = 38.8%, range 31 – 48.25%). When investigator support was withdrawn for one maintenance session, TI decreased to 35.5%.

Social Validity and Maintenance Rating Scale and Qualitative Comments

Table 1 displays each parent’s rating of each item on the Social Validity and Maintenance Rating Scale, along with means for each participant, each item, and each domain. Parents indicated an average total rating of 4.1 out of 5 on the Social Validity and Maintenance Rating Scale. Per participant, average ratings were 4.1 for Viola, 4.4 for Latisha, and 3.7 for Talia. Across participants, average ratings per question ranged from 3.3 to 4.7. Highest rated items were “The behavior management strategy was a good fit for my child,” and “Based on training from the study, I use some principles of the behavior management strategy to help manage my child’s behavior.” Lowest rated items were “Using the behavior management strategy did not take up too much of my time” and “I use the behavior management strategy as trained.”

While completing the Social Validity and Maintenance Questionnaire, participants were asked follow up questions about their ratings. Viola stated that she enjoyed implementing the behavior management strategy with Evan and would continue using it because it was effective and provided needed structure to leisure time. She described the strategy as clear, easy to use, and a good fit for her child because he is a visual learner. Viola did feel that implementing the intervention was time-consuming and interfered with her regular routines; however she reported that the demands on her time and energy were acceptable given the improvement in her child’s behavior. She felt that the strategy improved the atmosphere at home in that Evan showed fewer “meltdowns” when it was in place. While she reported that she did not use the strategy exactly as trained, Viola strongly agreed that she used some principles of the strategy to help manage her child’s behavior. Specifically, she described using visual supports across Evan’s day to break down steps of
an activity and provide a reward at completion.

Latisha said she enjoyed implementing the strategy and would continue to use it because Prince enjoyed it and it made him more independent. She also strongly agreed that the strategy was a good fit for Prince and easy to use with him. While she felt that some aspects of the intervention were a burden, she thought that overall it saved time and improved Prince’s behavior and her home routines. She especially liked the simplicity of the strategy, and stated that a lot of interventions overcomplicate simple problems and that is why she consolidated the steps of Prince’s after school routine onto a dry erase board during the maintenance period. She said she felt she had to change the intervention to better fit with her life. She acknowledged that she did not use the behavior management strategy exactly as trained but that she used some principles of the strategy to manage Prince’s behavior. Specifically, she described explicitly stating or writing the routine she expected from Prince at different times and places throughout the day. One aspect of the intervention that she discontinued was praise; Latisha did not feel that she should praise Prince except for superb performance, such as cleaning his room exceptionally well, due to concerns that he would start to expect praise for routine behavior.

Talia stated that she enjoyed implementing the strategy and thought she would continue using it but suggested she would be less likely to use it when Clarice was having a “bad day.” She found the intervention difficult to implement and, while she thought it was a good fit for her daughter, she was concerned that it might aggravate Clarice. Talia felt that imple-

<table>
<thead>
<tr>
<th>Items</th>
<th>Domain</th>
<th>Viola</th>
<th>Latisha</th>
<th>Talia</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I enjoyed implementing the behavior management strategy with my child.</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4.3</td>
<td></td>
</tr>
<tr>
<td>2. I think I will use the behavior management strategy with my child in the future.</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4.3</td>
<td></td>
</tr>
<tr>
<td>Overall support for intervention (M)</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4.3</td>
<td></td>
</tr>
<tr>
<td>3. The behavior management strategy was easy to use with my child.</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>4. The behavior management strategy was a good fit for my child.</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4.7</td>
<td></td>
</tr>
<tr>
<td>Fit with family/Ease of use (M)</td>
<td>4.5</td>
<td>5</td>
<td>3.5</td>
<td>4.4</td>
<td></td>
</tr>
<tr>
<td>5. Using the behavior management strategy did not interfere with my home routines.</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>3.7</td>
<td></td>
</tr>
<tr>
<td>6. Using the behavior management strategy did not take up too much of my time.</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>Time/burden of implementation (M)</td>
<td>2</td>
<td>4.5</td>
<td>4</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>7. The behavior management strategy improved my child’s behavior at home.</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4.3</td>
<td></td>
</tr>
<tr>
<td>8. The addition of the behavior management strategy improved the atmosphere in my home.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Intervention produces positive effects (M)</td>
<td>5</td>
<td>4</td>
<td>3.5</td>
<td>4.2</td>
<td></td>
</tr>
<tr>
<td>9. I use the behavior management strategy as trained.</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>10. Based on training from the study, I use some principles of the behavior management strategy to help manage my child’s behavior.</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>4.7</td>
<td></td>
</tr>
<tr>
<td>Maintenance of the Intervention (M)</td>
<td>4</td>
<td>4.5</td>
<td>3.5</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>4.1</td>
<td>4.4</td>
<td>3.7</td>
<td>4.1</td>
<td></td>
</tr>
</tbody>
</table>

Note. 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree.
menting the intervention interfered with other activities but that this was acceptable given the importance of getting Clarice to eat more slowly. Regarding this goal, Talia repeatedly described feeling conflicted between sympathizing with Clarice being hungry and wanting Clarice to eat more slowly. However, she strongly agreed that using the behavior management strategy did not take up too much of her time, and indicated an interest in extending the strategy to more of Clarice’s meal. When asked whether the behavior management strategy improved her child’s behavior, Talia was not sure. She stated that she thought there were some days when Clarice showed improvement and that perhaps it was starting to work. She emphasized the importance of using strategies consistently with Clarice and admitted that she had not used the strategy when the investigator was not present, suggesting that if she had it might have been more effective. She also expressed concern that Clarice’s group home was not working on getting her to eat more slowly and felt that their lack of intervention may have decreased the effectiveness of the intervention at her home. Talia was not sure that the behavior management strategy improved the atmosphere in her home and felt that waiting to take a bite continued to be hard for Clarice. When asked whether she used some principles of the strategy to help with Clarice’s behavior, Talia said that she did by verbally prompting Clarice to eat more slowly.

Discussion

No previous studies have purposefully examined the effectiveness and acceptability of parent-implemented behavior interventions for children with ASD in African American families. The purpose of this study was to gain preliminary evidence regarding the effectiveness of research-based parent-mediated behavior interventions (differential reinforcement and visual supports) with African American families with children with ASD. In the process of this investigation, (a) a multiple baseline across participants design was used to examine the effectiveness of interventions in changing child behavior, (b) parent TI data were collected throughout the duration of the study to examine parent implementation of procedures over time, and (c) parents completed a rating scale and were qualitatively interviewed regarding their perceptions of the effectiveness and acceptability of the intervention.

Specifically, this study attempted to answer three research questions. The first question asked whether a multiple baseline across participants design would show behavior interventions to be effective across purposefully sampled African American families with children with ASD. The results suggest the intervention was effective for two of three dyads. For Evan and Viola, introduction of parent-implemented differential reinforcement with visual support was associated with an immediate increase to 100% in Evan’s dependent variable of safe behavior, which remained at 100% for the remainder of the study including 4 months of maintenance sessions. For Prince and Latisha, introduction of parent-implemented differential reinforcement with visual support was associated with an increase in independent completion of steps of Prince’s after school routine, with the last two intervention sessions resulting in 100% completion. While results for Prince and Latisha became more variable during the maintenance phase, independent completion of steps remained well above baseline levels. For Clarice and Talia, introduction of the intervention was not associated with an increase in Clarice’s average IRT between bites of food. During sessions 28, 29, and 30, Talia was coached to add physical prompting to her verbal prompts, and IRT increased over these sessions with IRT in the 30th session meeting criterion of 8 s; however one follow up maintenance session showed IRT back at baseline levels. An examination of Talia’s TI indicates that while she used the visual support (usually after investigator prompting) she struggled to prevent Clarice from taking bites until the completion of each 8 s interval. Because of the lack of TI in this aspect of the intervention, taking a bite at the end of the interval was not differentially reinforced and therefore the timer and its “beeps” did not take stimulus control over Clarice’s eating.

The second research question asked whether parents would maintain procedures and results over time. Results show that Viola and Latisha implemented their interventions
with a relatively high level of TI during intervention phases when compared to baseline and that TI decreased over time during maintenance phases but averaged above baseline levels. Interestingly, decreased parent TI during maintenance was not associated with decreases in child performance, suggesting that the decreased levels of TI used by Viola and Latisha during maintenance were sufficient for maintaining their children’s levels of target behavior. It is possible that Viola’s and Latisha’s implementation was shaped such that only the components most necessary for maintaining their child’s behavior change remained. It is also possible that parents’ higher levels of TI during the intervention phase resulted in their children acquiring the skills needed to maintain target behavior with reduced support over time. Additionally it is possible that implementing the intervention changed parent behavior in a way that was not captured in TI measures. Talia’s results show that while her TI did increase after intervention, she did not implement the intervention with adequate integrity and her increased TI during intervention was not associated with increases in Clarice’s dependent variable. There are a number of possible explanations for Talia’s low TI. Spaced-responding DRL is relatively more technical and difficult to implement than the components of Viola’s and Latisha’s intervention, and is noted to produce slow changes in behavior even when TI is adequate (Cooper, Heron, & Heward, 2007). Additionally, Talia’s reported feelings of conflict regarding getting her daughter to eat slowly when she was hungry may have interfered with her implementation. Finally, Talia was the only parent whose child did not reside with her, resulting in Viola and Latisha having multiple opportunities throughout the week to use the intervention strategy and Talia having only one.

The third research question asked whether parents would perceive the intervention they received as acceptable and effective. Parents’ results on the Social Validity Rating Scale as well as their qualitative statements indicate that overall all three parents found their interventions effective and acceptable. In particular, all parents felt that the intervention strategy was a good fit for their child and that they would continue to use the strategy in the future. Talia’s ratings and qualitative statements, however, indicated less agreement with certain items in the rating scale, presumably reflecting the difficulty she had with implementation and the reduced effectiveness of her intervention. Additionally, while Viola and Latisha indicated overall support for the effectiveness and acceptability of the intervention, both mothers decreased TI over time and adapted aspects of the intervention to better suit their needs. As Latisha described in her qualitative comments, both appear to have supported the intervention in general but felt the need to alter it to suit their particular needs.

Various limitations of this study need to be addressed. First, interventions tested in this study were packages of combined strategies and do not allow for an analysis of which components contributed most to intervention effectiveness. Second, TI ranged across dyads and both Viola and Latisha altered their implementation of the independent variable during the maintenance phase, which introduces a variety of uncontrolled variables into the intervention. Third, because the intervention was ineffective for the third dyad, it is not possible to conclude that there was a functional relationship between the intervention and the dependent variables. Finally, the social validity and maintenance questionnaire used in this study did not have evidence of validity and reliability, and therefore its results should be taken with caution.

Overall, results from this study provide some support for the conclusion that differential reinforcement and visual support as parent-implemented behavior interventions for children with ASD may be effective and acceptable for some African American families with ranging levels of SES. While the intervention was ineffective for one of the three dyads, the mother did report the intervention as generally acceptable and effective. Additionally, in the two dyads for whom the intervention was effective, parents maintained some aspects of the intervention and child results for the duration of the study, which included 15 and 13 weeks of maintenance. That these two parents maintained the intervention on their own may be considered additional evidence that they found it acceptable
and effective (Kennedy, 2002; Schwartz & Baer, 1991; Wolf, 1978).

Research into understanding how families of children with ASD representing minority groups respond to evidence-based interventions would be greatly enhanced by additional single-subject studies purposefully examining the effectiveness of such interventions with racially and socioeconomically diverse families. Research in this area would also be aided by researchers reporting race and SES of participants (Conroy et al., 2005; McLaughlin et al., 2012), which would allow a greater understanding of the populations with whom behavior interventions for children with ASD have been found effective. In terms of practice, this study offers preliminary evidence that differential reinforcement and visual supports may be successful home-based interventions for some African American parents to use with their children with ASD, and that practitioners working with African American families with ASD at home should consider their use for improving problem behavior.

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Effects of a Peer-Mediated Literacy Based Behavioral Intervention on the Acquisition and Maintenance of Daily Living Skills in Adolescents with Autism

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Abstract: Many adolescents with disabilities do not independently perform the daily living skills needed to be successful in typical community environments. Literacy Based Behavioral Interventions have been effective in promoting skill acquisition and maintenance in some learners, but have yet to be implemented to teach basic self-care skills. Also, LBBIs to date have only been implemented by teachers, job coaches, or other adult professionals. In this study, peer partners were taught to deliver an LBBI story involving making a sandwich to four adolescents with autism. Results showed that the students’ accuracy with the task increased dramatically after reviewing their stories about sandwich-making with the peers. These skills maintained after the peers stopped reviewing the LBBI stories with them. This study extends previous research on LBBIs by incorporating the stories into efforts to teach new skills, and by enlisting peers into the intervention.

Many adolescents with autism and other moderate to severe disabilities do not have the daily living skills needed to help them live and perform well in typical community environments. Regardless of specific disabilities, independence in such basic skills as grooming, dressing, hygiene, and meal preparation opens many doors to typical community routines, environments, and social relationships. Conversely, difficulty with these very basic life skills decreases positive post-secondary, employment, and community living outcomes (Carter, Austin, & Trainor, 2012) and increases the challenges that many adolescents and adults experience with peer social relationships (Miller & Chan, 2008).

Fortunately, the intervention literature holds a number of effective interventions that have proven effective when skilled teachers have targeted these skills for instruction. Four decades of intervention research has shown the effectiveness of individual and small group instruction using a variety of graduated guidance and prompting systems (Lent & McLean, 1976; Manley, Collins, Stenhoff, & Kleinert, 2008), permanent prompts (Alberto, Sharpston, Briggs, & Stright, 1986), behavior skills training applications (Fetherston & Sturmey, 2014; Rosales, Stone, & Rehfeldt, 2009; Shayne & Miltenberger, 2013), and numerous types of picture and video models and prompts (Gihak, Alberto, Taber-Doughty, & Gama, 2006; Lasater & Brady, 1995; Spriggs, Gast, & Ayres, 2007). The recent attention to video modeling and prompting interventions delivered by cell phones, PDAs, and tablets demonstrates that researchers continue to seek effective interventions in an attempt to increase access for these learners to enabling environments and relationships (Bereznak, Ayres, Mechling, & Alexander, 2012; Mechling & Savidge, 2011; Van Laarhoven, Kraus, Karpman, Nizi, & Valentino, 2010). As Mechling (2008) pointed out, the instructional technology for teaching self-care skills is encouraging and continues to evolve.

One instructional intervention has included
the use of story scripts in which learners can view a sequence of pictures and written scripts that provide examples and directions for completing a skill. These Literacy Based Behavioral Interventions (LBBIs) provide guided instruction within a literacy context using print or pictures as an instructional medium. LBBIs include a wide variety of literacy interventions, including social scripts (Krantz & McClannahan, 1998), social narratives (Collet-Klingenberg, & Franzon, 2008), picture activity schedule books (Spriggs et al., 2007), comic strips and cartoon representations of students (Daly & Ranalli, 2003), Social Stories™ (Gray, 1998), and other interventions that present opportunities for instruction and rehearsal through print and pictures (Weiss & Harris, 2001). These LBBIs incorporate instruction with sentences, phrases, written reminders, and stories along with photographs, drawings, comic strip illustrations, or other visual media. Integrating written instruction with visual cues reduces the abstract nature of learning for many youngsters (Quill, 1997), and integrating instruction in a social context further increases meaning. Far from relying on a specific formula for creating this learning media, most LBBIs are notable in their adaptability to the needs of learners, adapting the stories, language, and visuals to the learning characteristics of students.

To date, various LBBIs, and Social Story™ interventions in particular, have been reviewed to establish whether their efficacy matches their promise (Ali & Frederickson, 2006; Bucholz, 2012; Kokina & Kern, 2010; Sansosti, Powell-Smith, & Kincaid, 2004; Styles, 2011; Test, Richter, Knight, & Spooner, 2011; Weiss & Harris, 2001). These research reviews point out that the empirical studies have most frequently targeted problem behavior reduction, with a few targeting social communication skills. The Social Stories™ studies typically targeted difficulties that students had making activity transitions, including non-compliance, tantrums, and various forms of aggression. As a behavior reduction procedure, the intervention has been reasonably effective. Few studies, however, have examined the efficacy of these interventions to teach new skills and behaviors. In addition, these interventions typically target elementary-aged children and are implemented by teachers, although other adults (including parents) have delivered the instruction in a few investigations. Bucholz and her colleagues have expanded the application of LBBIs in particular by targeting employability outcomes, including adolescents and adults with intellectual disabilities in her studies, and delivering interventions in small group contexts instead of the typical 1:1 instructional formats (Bucholz, Brady, Duffy, Scott, & Kontosh, 2008; Keeter & Bucholz, 2012).

The purpose of this study was to explore ways to expand further the use of LBBIs, specifically to investigate whether the intervention might increase the positive adaptive behavior of adolescents with disabilities who will soon enter post-school roles and environments. We specifically sought to examine the efficacy of an LBBI to promote adaptive daily living skills, in this case, making a peanut butter and jelly sandwich. Next, we wished to explore whether LBBI might be effective when delivered by similar aged peers. If so, this could take on characteristics of a naturalistic and effective teaching procedure that relies less on a direct instruction technology, and more on a peer social context. We posed two research questions:

1. Will a Literacy Based Behavioral Intervention delivered by peers increase the acquisition of daily living skills by adolescents with moderate to severe disabilities?
2. If so, will these improvements maintain when the peers remove the LBBI story and intervention?

Method

Participants

Four adolescents with moderate to severe disabilities, who attended a public charter school for students with autism spectrum disorders (ASD), served as the target students. Each attended classes that utilized a standards-based curriculum. Each had an eligibility of ASD based on various evaluation instruments, and each indicated ASD as their primary disability on their Individualized Education Plans. Christian, Mark, and Craig were students in the same classroom. Mary and Mark also received occupational therapy.
Three other adolescents from the same school served as peer partners. The target students and peers were familiar with one another through participation in school-wide activities, such as school dances, lunch, and recess. All three peers had a primary eligibility of ASD. Peers were selected based on the following criteria:

- Reading levels were close to grade level;
- Followed teacher requests consistently;
- Academic work was up to date;
- Showed an interested and willingness to participate

In addition, James was classified with a specific learning disability and emotional behavioral disorder; Gina was also classified as having a language impairment. Michael was the only peer earning a standard diploma while James and Gina were earning a special diploma. All target students and peers provided assent to participate, and parents provided consent prior to initiating the study. Participant characteristics and student-peer dyads are summarized in Table 1.

**Table 1**

<table>
<thead>
<tr>
<th>Student (Peer Partner)</th>
<th>Ages</th>
<th>Eligibility and Services</th>
<th>Assessment Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christian (James)</td>
<td>17 (16)</td>
<td>ASD; Language Impairment</td>
<td>DAR: Grade 2; FAA Reading Performance Level 4 (Emerging)</td>
</tr>
<tr>
<td>Mark (James)</td>
<td>16 (16)</td>
<td>ASD; Language Impairment; Received Occupational Therapy</td>
<td>Full Scale IQ (UNIT): 41 DAR: Grade 1; CARS: Severe Autism; ADI-R: Met Autism Criteria; ADOS-2: Met Autism Criteria FAA Reading Performance Level 2 (Participatory)</td>
</tr>
<tr>
<td>Craig (Michael)</td>
<td>14 (16)</td>
<td>ASD; Language Impairment</td>
<td>Full Scale IQ (Stanford Binet): 46 GARS: Probability of Autism: Very Likely; FAA Reading Performance Level 2 (Participatory)</td>
</tr>
<tr>
<td>Mary (Gina)</td>
<td>15 (16)</td>
<td>ASD; Speech Impairment; Received Occupational Therapy</td>
<td>Brigance Grade 1; FAA Reading Performance Level 3 (Participatory)</td>
</tr>
</tbody>
</table>

*Note. FAA is Florida Alternate Assessment in Reading ("Participatory" indicates need for frequent prompting and limited depth of knowledge; “Emerging” indicates limited independent performance of preliminary skills); DAR is Diagnostic Assessment of Reading; CARS is Childhood Autism Rating Scale; ADI-R is Autism Diagnostic Interview - Revised; ADOS - 2 is Autism Diagnostic Observation Schedule; GARS is Gilliam Autism Rating Scale.*

**Task and Setting**

A daily living skill was selected based on three criteria. First, parents, teachers, and students were asked to nominate up to three skills that they wished to learn to perform independently. Second, the tasks were matched to each student’s IEP to verify the need for and importance of the skill. Finally, skills were examined for the practical aspects of instruction by peers in a school setting. Because food preparation was identified as a priority need and a preferred skill by each student, making a peanut butter and jelly sandwich was selected as the daily living skill. All instruction took place in one of two areas of the school that contained an area for meals and meal preparation. The first location was the school lunchroom, an area containing tables with benches, a sink, refrigerator, cabinets and drawers. All materials necessary for the task were placed on the countertop before the sessions began. The second area was in a vocational area of the school designed to replicate a restaurant. This area contained a table with benches and a cart with restaurant supplies such as napkins, forks, and knives. The
setting was chosen each day based on availability of the location, and all baseline, intervention, and maintenance measures were collected in these two settings.

Behavioral Measure, Data Collection, and Interobserver Agreement

A task analysis was the behavioral measure for each student. The task analysis contained 14 steps and, in turn, was used to construct the LBBI story that formed the basis of instruction. Data were collected individually for each student by observing the student build the sandwich, and scoring each step as (a) correct and independent, (b) incorrect, or (c) correct but accompanied by peer coaching or guidance. Coaching and guidance was defined as a peer delivering a prompt in response to a student making an error or not initiating a step within 30 seconds. Steps did not have to be performed in a strict order, although some steps required an inherent order (e.g., the jar had to be opened before peanut butter was spread on the bread). Only steps that were correct and independent were used for instructional decisions.

Data were collected using paper-pencil recording sheets by one to two observers stationed away from the students, yet still within range of sight and hearing. Typically, the distance between observers and students was between 5–10 feet. Both observers were experienced teachers attending a graduate program in special education. Both observers were trained to use the data collection system and practiced using the data sheets prior to the study.

On 42% of the sessions both observers recorded performance simultaneously for purposes of assessing interobserver agreement. This accounted for 40% of the sessions for Christian, 38% for Mark, 44% for Craig, and 54% of the sessions for Mary. Agreement across all students was 99%.

Development of the LBBI

Prior to baseline, and after the sandwich-making skill was task analyzed, a story book depicting how to build the sandwich was constructed. Although the task analysis contained 14 separate steps on which we collected performance data, we combined several of the steps so that the actual story book contained only 8 pages. Each page consisted of one to two photographs of a student performing steps from the task analysis, taken from a point-of-view perspective. That is, each photograph showed a skill from the perspective of the student performing the task (Schreibman, Whalen, & Stahmer, 2000). At the bottom of the page, a sentence or phrase was typed describing what the student in the picture was doing. The length of the story ranged from 7 to 12 words for page \( (M = 9.6 \text{ words per page}) \). Pictures were approximately 6 x 8 inch color photographs; all words used Calibri 44 size font. Each page was held in a laminated sleeve, and the story pages were collected in a 1 inch, 3-ring binder. A summary of the story book for making a peanut butter and jelly sandwich is found in Table 2.

Experimental Procedures

During baseline, the peer stood next to the student who made the sandwich. A researcher asked the student to “make a sandwich” and data were recorded based on steps completed correctly and independently. Sessions ended when students stated or otherwise indicated that they had completed their sandwich. During baseline, the peer was present but did not interact with the student during the session.

Prior to the intervention, training on the core elements of the LBBI was conducted with each peer. This peer training was conducted for approximately 20 minutes, for 2 days for James and 3 days for Michael and Gina. The peers were taught to read, point to, pause, practice, and provide reinforcement for each step that was completed correctly. Peer training concluded when they demonstrated the procedure twice with 100% fidelity with an experimenter.

When the LBBI was implemented, the peer sat next to the student with the book on the table in front of them. The peer then read the story, using the additional components of the LBBI (point, pause, practice, and reinforce), to the student. Once all the pages of the story were completed the peer asked the student to “make a sandwich.” While the student made the sandwich the peer stood within 5 feet to prompt if necessary. If the student
made an error or did not initiate a step within 30 seconds, the peer provided a prompt by opening the story to the corresponding page in the LBBI, and re-reading the page and pointing to the picture.

Finally the LBBI was removed for each student to evaluate whether any gains would maintain in the absence of instruction. Our criterion for removing the LBBI was that the students would complete at least 93% of the steps accurately, without prompts, as long as their performance demonstrated that they could indeed build a complete and edible sandwich. The LBBI was removed for Christian after 12 sessions, with follow-up observations 10, 23, and 30 days after the last intervention. This pattern was repeated for each student. The LBBI was removed after 14 sessions for Mark, 13 sessions for Craig, and 11 sessions for Mary. Follow-up observations were held 9 and 16 days after the LBBI for Mark, 11 and 27 days after the LBBI for Craig, and 7 and 30 days for Mary.

**Experimental Design**

All baseline, intervention, and maintenance observations were collected during a single session each day. A multiple baseline design across participants was implemented to assess the effects of the LBBI with each student. The design incorporated multiple probes during baseline to avoid exposing students to extended period of practice without intervention. For each student a follow-up condition without the LBBI was implemented to assess potential maintenance several weeks after the instruction was removed.

**Results**

The effects of the peer-mediated LBBI are shown in Figure 1. During baseline, none of the students demonstrated the ability to make the sandwich accurately and independently. For Christian, Mark, and Craig, each baseline probe was stable and below 35%. Mary’s baseline accuracy was higher, but never exceeded 73%. When the peer-mediated LBBI was implemented, all students improved their accurate and independent performance substantially. Christian achieved a stable 100% responding starting on his sixth intervention session. Mark immediately improved his performance, remained above 90% on 9 intervention days, and reached 100% on 3 days. Craig took three intervention sessions to exceed 90%, then remained there for the rest of his

**TABLE 2**

Summary of Students’ LBBI

<table>
<thead>
<tr>
<th>Page &amp; Story Content</th>
<th>Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Get out 2 pieces of bread. Put them on your dish.</td>
<td>Two photos are present on the page. One photo shows a loaf of bread. The other photo shows 2 slices of bread on a plate.</td>
</tr>
<tr>
<td>2. Open the jelly. Open the peanut butter.</td>
<td>Two photos are present on the page. One photo shows a picture of a hand opening a jar of jelly. The other photo shows a picture of a hand opening a jar of peanut butter.</td>
</tr>
<tr>
<td>3. Get out one scoop of peanut butter. Spread it on the bread.</td>
<td>Photo shows a hand spreading peanut butter on a slice of bread.</td>
</tr>
<tr>
<td>4. Get out one scoop of jelly. Spread it on the bread.</td>
<td>Photo shows a hand spreading jelly on a slice of bread.</td>
</tr>
<tr>
<td>5. Put one slice of bread on top of the other.</td>
<td>Photo shows picture of an open sandwich and another picture of a closed sandwich.</td>
</tr>
<tr>
<td>6. Close the jelly. Close the peanut butter.</td>
<td>Page contains a picture of a hand closing a jar of jelly and another picture of a hand closing a jar of peanut butter.</td>
</tr>
<tr>
<td>7. Cut your sandwich or ask your friend to cut it for you.</td>
<td>Page shows photo of a sandwich being cut in half and another photo of a sandwich in two pieces.</td>
</tr>
<tr>
<td>8. Give ½ to your friend and eat your sandwich.</td>
<td>Page contains a photo of a sandwich with a bite missing.</td>
</tr>
</tbody>
</table>
Figure 1. Percentage of correct and independent steps of the task analysis for making a peanut butter and jelly sandwich.
intervention sessions. Mary also showed an immediate increase in her performance, exceeding 90% on her first day of using the LBBI with her peer, and remained above 90% on 6 days.

When the peers stopped delivering the LBBI Christian maintained his sandwich making accuracy at 100% on each follow-up observations across the next 30 days. Mark and Craig also maintained their skills, demonstrating 100% independent accuracy on 1 of 2 observations across the next 16 days for Mark, and 2 of 2 observations for Craig across the next 27 days. Mary’s performance during the follow-up observations was somewhat more variable, with scores between 86% and 93% across the next 30 days.

Discussion

Each of the four students who received an LBBI delivered by a similar aged peer increased the ability to perform the daily living skill. Each student also maintained the new skill during follow-up observations 9 to 30 days after the peers stopped delivering the intervention. The findings strengthen the evidence base for using LBBI to promote daily living skills, and extend the efficacy of the intervention by including peers in the delivery. Also, improvements in student responding were rapid, with all students making sandwiches independently within 4 days of their first exposure to instruction. As such, it appears that the peer-mediated LBBI holds potential as a teaching procedure for some students with autism and other moderate to severe disabilities.

As Bucholz et al. (2008) pointed out many LBBI include a host of procedures that combine to create an effective package of instruction. For example, the peer-mediated LBBI in this study incorporated imitation and discrimination training with picture models for each step in the task analysis. For example, on each page of the story the peer showed the student how to perform steps of the skill using verbal instructions and modeling, followed by corrective feedback and/or praise (e.g., an open vs an unopened jar). Also, the pictures and text gave a structured sequence for the skill, and peers encouraged the students to rehearse the skill as they worked through the pictures and text. These procedures are common to most behavioral skills training protocols (Fetherston & Sturmey, 2014; Shayne & Miltenberger, 2013), and are also commonly found in direct instruction demonstrations common to daily living skill interventions (Cihak et al., 2006; Mechling, 2008). In this study we did not attempt to isolate various instructional procedures that might be most efficacious, but instead sought to establish whether the intervention package would be effective when delivered by peers. Also, we did not investigate the relative effectiveness of peers versus adults in delivering the LBBI; rather, we sought to learn only whether similar-aged peers might play an effective role in delivering this intervention. Since peer-mediated interventions require a good deal of social awareness and observational learning, it was not clear whether this approach would be effective for learners with autism. It is possible that certain components of the intervention (e.g., picture models and rehearsal) enabled the peers to be effective, and our future studies will pursue this possibility.

Like all studies this one had limitations. First, all of the students were taught the same daily living activity. This limits any demonstration of effectiveness to a single skill; certainly a study in which multiple skills were selected would have strengthened the outcomes greatly. Second, we did not assess any generalized outcomes beyond skill maintenance. Given the generalization difficulties faced by most students with autism and other moderate to severe disabilities, it would be important to examine whether an LBBI that is peer-delivered might lead to generalization of newly learned behavior to other children or adults. Any evidence that a peer-mediated LBBI might produce generalized learning across other people would be an encouraging outcome. Third, for two of the four participants, we collected only two baseline sessions before implementing the LBBI. Additional baseline probes would add greater confidence in the stability of these adolescents’ baseline performance. Finally, we note that 3 of the 4 students did not consistently perform 100% of the steps in this task. While they demonstrated 13 of the 14 steps consistently, these students sometimes failed to perform all steps to independent mastery. A post-hoc analysis of the
data shows that the students sometimes failed to complete the skill of cutting the sandwich in half once they finished making it. We also observed a frequent error in spreading the peanut butter to cover all areas of the bread. Although these performance errors appear relatively minor and did not interfere with task completion, they showed that some steps might require additional training power which might include additional pictures, rehearsal, or peer guidance.

Perhaps the variance observed here is a natural phenomenon, reflecting the personal preference of individuals (see Bannerman, Sheldon, Sherman, & Harchik, 1990), or the form versus function phenomenon long identified as a critical consideration when establishing performance parameters (White, 1980). Mary’s performance should be considered with both of these caveats in mind. Although Mary’s baseline performance exceeded that of the other students, she never completed 100% of the steps accurately and independently during the intervention or maintenance. Each error during intervention was relatively minor, and none precluded completion of the actual skill. In fact, Mary appeared to enjoy the LBBI activity and interaction with the peer, and always ate the sandwich at the conclusion of the activity. A critical visual analysis of Mary’s sandwiches might conclude that some had a minimal amount of jelly, while on others she failed to spread the peanut butter evenly in all quadrants of the bread. From this perspective, inconsistencies in the form of the performance (e.g., not spreading the peanut butter on [3/4] of the bread) sometimes penalized her performance score, although the function of the performance (making and sharing a snack with a peer) clearly met expectations. From a research perspective however, this variance demonstrates that the peer-mediated LBBI had a robust influence on, but not complete experimental control over, students’ performance.

Although these limitations lead to future research possibilities, there are other research questions suggested by our findings. First, it is not clear whether peer-mediated LBBI s might be effective for other student outcomes. Research syntheses to date show that LBBI s, and Social Stories™ in particular, typically have been employed for problem behavior reduction, and exclusively delivered by adults (Kokina & Kern, 2010; Sansosti et al., 2004). Using LBBI s to teach new skills and routines has been pursued by very few researchers (Bucholz, 2012; Test et al., 2011). The promise of this class of interventions as a form of naturalistic instruction for other daily living routines, language and academics, and other adaptive behavior is encouraging, and our future studies will indeed target these outcomes. Second, we believe that LBBI s also hold promise as a tactic for promoting generalized learning. Because most LBBI s incorporate multiple teaching components it is possible that an intervention could include at least one or more tactics that frequently produce generalized learning (e.g., common stimuli, multiple training examples, indiscriminable contingencies). Finally, a natural progression of this research would be to extend the format of the LBBI to other media for delivery, including tablets or other portable electronic devices. With the increasing availability of such technologies it is possible that integrating an LBBI into an electronic medium would enable teachers and others to produce stories with design features that enhance the realism of the skills and routines that are targeted for training (Mechling, 2008). These evolving technologies also could increase the portability of the LBBI so that instruction could be delivered in a range of community sites.

As the evidence base for effective interventions expands, investigators will continue to explore novel ways to implement interventions in hopes of finding ever more robust tools that promote learning and performance in students with autism and other moderate and severe disabilities. Incorporating peers into the delivery of LBBI s appears to hold promise as an effective strategy for teaching daily living activities. We believe it should be explored as a promising practice for other positive outcomes as well.

References


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Abstract: The demands of money-counting skills potentially limit individuals with intellectual disability (ID) to master the one-more-than technique, particularly in Taiwan, which requires high daily minimum living expense for supporting an individual’s daily life. Employing a multiple treatment design across price ranges and settings, this study compared effects of two approaches of the one-more-than technique on the independent payment for four male secondary school students with moderate ID. Results demonstrated that the approach using the mobile purchasing assistance system (MPAS approach), embedded with the one-more-than technique, was of greater benefit than simply using the traditional one-more-than technique (TOMT approach) to instruct students with inconsistency of money-counting skills to independently purchase goods costing high a level of price range, reaching the daily minimum living expense in local environment. Furthermore, the newly acquired skill was effectively maintained and generalized to four non-trained new environments for at least eight weeks after the removal of the MPAS intervention.

Generally, the majority of necessities in daily life involve the use of the money-related skills, including eating, clothing, traffic, education, and entertainment. As they transition from school to community settings, individuals with intellectual disability (ID) have more and more opportunities to deal with money-related tasks (Denny & Test, 1995). Money-related skill is a core component of independent community functioning (Cihak & Grim, 2008), potentially affecting involvement within various community settings (Schlein, Certo, & Muccino, 1984).

However, numerous studies indicated that as they transition into the community, individuals with ID often struggle to obtain independence (Rapanaro, Bartu, & Lee, 2008; Winn & Hay, 2009), which partially required the independent living skills involved in complex money-related tasks, particularly purchase payment (Denny & Test, 1995; Westling & Fox, 2008). Another finding from National Longitudinal Transition Study-2 also reports that young adults with disabilities are less likely than those without disabilities to have the money usage skills that would possibly promote more independence in the community (e.g., spending and saving money management; Newman et al., 2009). In addition, an investigation from the perspectives of 68 persons with ID also showed similar results that lack of necessary knowledge and numeracy skills were identified as a main barrier to access community facilities. Appropriate skills training is the suggested
solution proposed to overcome this barrier (Abbott & McConkey, 2006).

Therefore, enhancing the ability of money usage would promote people with ID to independently access various community services (e.g., shopping in a mall, eating in a restaurant, and purchasing tickets for using a leisure facility; Xin et al., 2005). More and more researchers regard the ability of making purchases as a necessary skill for independent community functioning and lacking this skill would impact activities, such as purchasing items for leisure activities (Schlein, Certo, & Muccino, 1984), making purchases in a bookstore (Cihak & Grim, 2008), purchasing and eating at a restaurant (Denny & Test, 1995; Mechling, Priddgen, & Cronin, 2005), and shopping in a grocery (Ayres, Langone, Boon, & Norman, 2006). The acquisition of purchasing skills had been identified as an essential daily living skill (Schloss, Kobza, & Alper, 1997) and a high treatment priority for people with ID in order to increase their independence (Ayres & Langone, 2002; Colyer & Collins, 1996). Making purchases is a complex procedure, involving selecting planned items (Bouck, Satsangi, Bartlett, & Weng, 2012) and payment (Cihak & Grim, 2008; Denny & Test, 1995; Schlein, Certo, & Muccino, 1984; Wu, 2006). In this study, we focused the behavior of making purchases using real money for payment in community settings.

The One-More-Than Technique for Purchasing Skills

For decades, many alternative strategies were proposed in order to effectively enhance the purchasing skills for those with ID. A meta-analysis by Xin, Grasso, Dipipi-Hoy, and Jitendra (2005) indicated that the one-more-than technique was one of effective treatments on instructing people with ID on independently payment. The one-more-than technique was referred to as paying one more dollar than the requirement from a cashier, which consisted of three following components. First, if the items cost $4.28, a purchaser needed to prepare the amount of dollar (i.e., four dollars). In other words, he/she would use the counting-on strategy to prepare the dollar part, which is central entry for the one-more-than technique (Cihak & Grim, 2008; Denny & Test, 1995). Second, if necessary, the purchaser would put $1 for the cents pile (e.g., 28 cents), which is called the cents pile modification, as proposed by Test, Howell, Burkheart, and Beroth (1993). Finally, combine the counted dollars and one more $1 before paying a sales clerk.

Although the effectiveness of traditional one-more-than technique has been demonstrated on independent payment for individuals with ID in United States, the previous empirical studies only demonstrated that the traditional one-more-than technique could be effective if the items costing no more than $35 dollars (i.e., purchased items with $9, David & Robert, 2008; $9.9, Ayres et al., 2006; $20, Cihak & Grim, 2008; Denny & Test, 1995; Test et al., 1993; and $35, Colyer & Collins, 1996). Findings in the above studies also reveal that use of the traditional one-more-than technique by users good at the money counting-on skill did not buy goods at a price that exceeded their counting capacity.

However, 35 dollars could hardly purchase anything in Taiwan, which requires more money to support daily life. No studies were conducted in relation to the evaluation of this technique’s effects in local community settings in Taiwan, except the study by Wu (2006). The results from this study not only demonstrated paying one more ten coin than required, called ten-more-than technique, was an effective treatment as individuals purchased items costing no more than NT$100 in Taiwan (New Taiwan dollar, abbreviated as NT$), but also confirmed that ten-more-than technique would be more complicated if the counting was more than 100. According to the records published by the Taiwan government, however, NT$626 dollars was the minimum living expense for supporting individual daily life in Taiwan (Directorate General of Budget, 2013). Larger amounts of money requires higher prior knowledge regarding money counting skills and more complex and difficulties to be faced as using the concept of the one-more-than technique to purchase (Xin et al., 2005). Therefore, it could be interpreted that the price range, NT$1-NT$100, feasible for the ten-more-than modification, proposed by Wu (2006), is far from reaching a minimum cost of day-to-day living in Taiwan. In other words, there is a need for proposing
another feasible modification of the traditional one-more-than technique and exploring its effectiveness on the higher price range level for the local circumstances and currency in Taiwan.

**Mobile Devices Used For Facilitating the Acquisition of Functional Skills**

With an increase in advocacy for full participation in the local environment and the rise of innovational technologies, the embrace of mobile devices into daily functional skills for those with ID has gained great attention. It was well documented that individuals with developmental disabilities might benefit from the use of mobile devices to facilitate the acquisition of various functional skills, including vocational skills (Burke, Andersen, Bowen, Howard, & Allen, 2010; Cihak, Kessler, & Alberto, 2008), cooking skills (Taber-Doughty et al., 2011), communicative skills (Achmadi et al., 2012; Flores et al., 2012; van der Meer et al., 2011), and engagement in causal leisure activities (Hammond, Whatley, Ayres, & Gast, 2010; Kagohara, 2011). Contrary to the growing extant literature on incorporating mobile devices into functional skills, however, no studies regarding the exploration of the effects of the assistance of mobile devices on the procedure of the independent purchases was found, except the planned shopping list (Bouck et al., 2012). Three male high school students with moderate ID participated in the withdrawal design conducted by Bouck et al. (2012) for comparing the effectiveness between digital audio shopping list and the traditional picture-based shopping list on the percentage of independently obtaining the planned items. Findings indicated that the audio-based shopping list was not superior to the traditional mean of picture-based list. But Bouck and her colleagues (2012) noted that convenience in creating a shopping list was the advantage of the approach using the digital audio recorder.

Considering the literature reviewed, an empirical-based study was needed to further clarify whether the introduction of mobile technologies would be effective for people with ID, who had inconsistent money-counting behavior, to independently pay money across the levels of prices ranging from NT$1-NT$100, NT$101-NT$500 and NT$501-NT$1000, based on their local daily minimum living expense in Taiwan. The purpose of this research was to determine the effects of the two modifications of the one-more-than technique (i.e., the MPAS approach and the traditional approach with paying one more larger dollar, called TOMT approach) on independent payment. Furthermore, other potential factors (e.g., three levels of price range, and two community settings) were also included to further explore its immediate, maintenance, and generalization effects for four participants, who had inconsistent money-counting behavior and lived in a country demanding a higher amount of money to maintain their daily lives.

**Method**

**Participants**

Four male secondary school students with moderate ID participated. Ages of participants ranged from 14 years to 15 years with a mean of 14.5 years. The IQs of Luo, Wang, Li, and Zeng were 41, 45, 47, and 41, respectively, as measured by the Wechsler Intelligence Scale for Children IV. Participants had the following prerequisite skills.

a. Candidates could identify NT$5, NT$10, NT$50 coins and NT$100 bills, NT$500 bills.

b. Motor ability to touch the button on a mobile device with a 4.3-inch touch screen.

c. Purchasing skill was a learning objectives in their Individualized Education Program.

d. Candidate students and their parents consented to participate.

All participants did not have any significant health problems, including visual, physical, or aural problems. According to the reports by teachers and parents, the four participants were distracted by irrelevant events around them (e.g., noises, large movements, etc.). Verbal and physical reminders were considered effective ways to help them focus more on their work.

**Participants’ prior knowledge of money counting skills.** Before the experiment, an informal assessment involving money-related skills was conducted, which was entirely designed to ex-
plore the prior knowledge as participants counted money. The results indicated that although the participants could count the single-type money with NT$1 coins from 0 to 50, the money-counting behavior was not stable and was inconsistent (i.e., for the same question, they counted the money in various ways, called inconsistent money counting behavior) and failed to correctly count the money mixed with two or more types of coins or bills. Additionally, participants had good performance at (a) picking up the money one by one, (b) recognizing the money, including NT$1, NT$5, NT$10, NT$50 coins, and NT$100, NT$500 bills, and (c) preferring to count out all the money. These findings were incorporated into the construction of the modification of the one-more-than technique in the MPAS.

**Settings**

Except for the training phase, data were collected in the supermarkets and convenience stores (Supermarkets: RT-Mart, Well-come and Poya; Convenience stores: Hi-Life, 7–11 and Family) located in community settings during baseline, intervention, maintenance, and generalization phase. Three convenience stores and three supermarkets within a five-mile radius from participants’ homes were selected based on the top three most popular sites proposed by participants’ parents in this study.

Except for the baseline including these six sites, RT-Mart and Hi-Life were included during the intervention and maintenance phase while Well-come, Poya, 7–11, and Family were utilized in the generalization phase. Participants’ special education classroom was only used for the training of the operation of the MPAS before the MPAS intervention phase.

**Materials**

*The MPAS.* The MPAS was an Android-based application package file (APK), which runs in a mobile device and was written by the first author in the Flash ActionScript CS3 language. Three scaffolding mechanisms were provided to help individuals with ID make purchases: (a) process scaffolding (i.e., providing the procedure prompts to guide individuals with ID process the purchases); (b) number and calculation scaffolding (i.e., embedding the one-more-than technique in the system in order to facilitate money-counting and calculation); and (c) transaction tracking scaffolding (i.e., automatically recording transaction information in a database, such as date and time, the amount of money etc.). The MPAS was entirely designed to cope with the inconsistent money-counting behavior of participants. Additional information regarding the use of the MPAS is illustrated in Figure 1.

**Real money.** All phases were provided real money, several NT$10, NT$50 and NT$100 dollars etc. Under the traditional approach, participants were taught to use the one-more-than technique to make purchases. They would use counting-on skill and pay one more ten/fifty coin or one hundred bill than requested to prepare the payment. In contrast, under the MPAS approach participants would be asked to operate the MPAS, which was embedded the one-more-than technique, and follow the prompt provided by the MPAS to pay real money to a cashier.

**Task analysis of making purchases.** The task analysis of making purchases was in accordance with the research purposes of the study, the comparison of two modification approach of the one-more-than technique. Steps in this task analysis include (1) count the money I have in my wallet using regular math counting-on skills; (2) record the sum of the money in the MPAS; (3) select the required items; (4) take selected items to cashier’s counter; (5) record the price of the selected goods in the MPAS; (6) prepare the money I would pay, based on the price number shown in a cashier register; and (7) pay a salesclerk. With the exception of steps 2 and step 5, only for the MPAS intervention, all steps would be executed across the MPAS intervention and the traditional one-more-than technique. Step 1 was designed for examining whether the money-counting skills of participants improved and reached the amount of provided money. Therefore, all steps would be executed even if step 1 was incorrect.

**Experimental Design**

We used a multiple treatment design across three price ranges and two community settings (Tawney & Gast, 1984). Figure 2 illus-
trates the experimental procedure, including five phases (i.e., baseline, training, intervention, maintenance, and generalization) after the end of an informal assessment regarding the participants’ prior knowledge of money-counting skills. Moreover, the treatment sequences in the intervention, maintenance, and generalization phases depended on which group the participant was assigned to; this counterbalance technique was employed to reduce potential carry-over effects caused by the fixed sequence (Kennedy, 2005).

**Procedure**

Four participants were randomly assigned to two groups. Luo and Wang were assigned to group 1, trained in the following sequence: baseline; the MPAS training, the MPAS intervention, the traditional one-more-than intervention, the MPAS maintenance, the traditional one-more-than maintenance, the MPAS generalization, and the traditional one-more-than generalization. Group 2, composed of participants Li and Zeng, completed the reverse sequence of the intervention, maintenance and generalization phases.

All phases contain assessment probes and had the same procedure for collecting data.

a. All data was collected in real stores in a local community (convenience stores and supermarkets.), except the training phase.

b. Five sessions were provided per week. Each session was composed of 20 assessment probes.

c. No additional instructions and feedback were given during the assessments probes.

d. If no response was offered within 5 seconds, the teacher would ask: “Are you finished?” An assessment would be terminated if a participant replied something like: “Yes!” and went through the next step (to take a one-minute break), followed by another assessment, or if the end of the assessments in this phase had been reached.

The five phases were as follows.

a. **Baseline phase:** The purpose of the baseline phase was to evaluate the participants’
prior knowledge regarding making purchases in two community settings. If a minimum data point of three consecutive sessions with a stable level in the baseline phase was established, the intervention phase was introduced to a participant.

b. MPAS training phase: Prior to the MPAS intervention, participants were introduced to the system. Four training sessions of approximately 80 minutes were conducted in a special education classroom. The main training was (a) how to turn on the mobile device and activate the MPAS, the instructor described and modeled, then participants repeated the model; (b) how much money in the wallet: the instructor took the money from the wallet and recorded the mixed money composed of several types of coins/bills into the MPAS, then participants repeated the model and practiced for three new amounts within NT$50; (c) how much money do items cost: the instructor wrote the price of the items on paper and modeled how to key in this price into the MPAS, then participants repeated the model and practiced for three new amounts; (d) prepare money I would pay: the instructor prepared the money based on the prompt provided by the MPAS, then participants repeated the model and practiced for three new amounts within NT$50.

The context in this phase did not include any information regarding how to use this system to make a purchase. The purpose of this phase was training participants to correctly operate the MPAS before the intervention phase rather than how to use the MPAS to make a purchase. Therefore, the training phase was only for the MPAS approach not for the TOMT approach. In addition, the setting for the training phase was participants' special

Figure 2. Experimental procedure.
education classroom and the amount participants were given in a wallet was within NT$50 dollars.

c. Intervention phase: The intervention phase aimed to evaluate the immediate effects of the MPAS and the traditional one-more-than technique on making whole purchases, which were potentially beyond the participant’s counting skills in two community settings. The two interventions were alternated if a minimum data point of three consecutive sessions with a stable level was established. A session in the intervention phase consisted of three aspects: (a) one modeling procedure lasting approximately 3 minutes; (b) at least two practice procedures of around 20 minutes; and (c) 20 assessments (around 3.5 minutes per assessment). Each assessment was followed by a 1-minute break. A 10-minute break was arranged during the transition between practices and assessments. All instructional procedures, practices, and assessments followed the task analysis of making purchases. The procedure in the MPAS approach in this phase was totally different from that in the MPAS training phase. The former focused on using the MPAS in the context of making purchases, and the later was training participants how to correctly operate the MPAS system. The criterion for acquisition was achieved if 100 percent independent purchases were made for three consecutive sessions.

d. Maintenance phase: The maintenance phase was conducted at least eight weeks after the removal of the intervention phase in order to evaluate the maintenance of the effectiveness of the intervention phase. The store used to evaluate the effectiveness of the maintenance of the treatment intervention was the same with the intervention phase. Data collection in this phase followed the task analysis of making purchases. The criterion for maintenance was achieved if at least two consecutive sessions with 100-percent independent purchases were made. In addition, 20 assessments with each one followed by a 1-minute break compose a session.

e. Generalization phase: The generalization phase aimed to evaluate the transference of skills attained in the intervention phase. Besides the generalization phase, generalization probes were also collected during the baseline phase in order to identify the prior knowledge of participants and further determine the generalization effect at two non-trained community sites.

Data Collection

Dependent variables. The comparison of effects between the two treatments on making independent purchases across three price ranges was the primary focus of this study. Therefore, independent payment served as a dependent. An independent payment was defined as using the counting-on strategy to prepare money and then paying one more dollar than required if necessary, which was in line with the study by Cihak and Grim (2008). Paying three NT$100 bills would be regarded incorrect, however, one NT$100 bill and two NT$10 dollars or two NT$100 bills were considered correct if the total price was NT$115 and a buyer had five NT$100 bills and four NT$10 dollars. That is because the latter follows the counting-on strategy and would produce the least change. The percentage of independent purchases was determined by dividing the number of correct purchases by 20, the total opportunities provided for individual participants each session, and multiplying by 100. Meanwhile, the generalization data were gathered in the baseline and generalization phases for further assessing the effects of newly acquired purchasing skill generalized to non-trained community sites. During the performance assessments, anecdotal records were conducted to collect qualitative data related to purchasing behavior.

Inter-observer agreement (IOA). Data were collected independently and simultaneously by an interventionist and a trained second observer on approximately 33 percent of the baseline probes, intervention probes, and maintenance for each participant (Kennedy, 2005). The trained observer has a 4-year Bachelor of Education degree with 10 years instructional experience in public elementary schools as a qualified education teacher. The interventionist in this study was a fifth-year doctoral student in the Graduate Institute of Network Learning Technology with 16 years
special educational instructional experience in elementary schools. An IOA was conducted to examine the reliability of measurement. This IOA was calculated by the number of agreements divided by a total of number of agreements plus disagreements, then multiplied by 100 (Kennedy, 2005). With regard to the payment, IOA was 100 percent for Luo and Zeng across all phases, and 96.6 percent for Wang, and 93.3 percent for Li in this study.

Social validity. Social validity refers to the acceptance and appropriateness of procedures and effects of the intervention to society (Schwartz & Baer, 1991). Social validity was solicited by surveying the significant others of the participants’ community, such as parents and teachers (Schwartz & Baer, 1991). The semi-structured interviews were conducted a week after this experiment to evaluate the acceptance of significant others regarding the participants’ community towards the procedures and effects of this intervention. Four special education teachers of the participants, four parents of the participants, and four cashiers who were responsible for at least three sessions were interviewed to validate the acceptability of the effects of the treatments. Furthermore, four special education teachers were interviewed to validate the appropriateness of the three treatment procedures. The interview was composed of several open-end interview outlines, based on the concepts, perceived usefulness, and perceived ease of use proposed by Davis (1986), shown as follows.

Interview outlines for special education teachers or parents of participants:

a. How acceptable do you find this treatment to be for the students’ or children’s independent purchases?
b. How do you feel about the usefulness of the MPAS for you, your children or students?
c. How do you feel about the ease of use of the MPAS for your children or students?
d. How much do you like this procedure used in this treatment for making purchasing?

d. How do you feel about the usefulness of the MPAS for those children and for your job?

c. How do you feel about the ease of use of the MPAS for students with ID?

Results

Effects of the Independent Payment Performance between the Two Treatments

Figures 3–6 illustrate participants’ percentages of independent payment across increasing price ranges and two community settings. Overall, the baseline data of four participants showed a stable trend of around 0 percent with no variability, with the exception of participant Li’s mean of 1.7 percent correction. During the MPAS intervention, all participants demonstrated independent purchases with a mean of 93% for NT$1-NT$100, 96.8% for NT$101-NT$500, and 99.4% for NT$501-NT$1000. The number of sessions to reach acquisition criteria declined as the price ranges increased (a mean of 7.25, 7, and 4 for three increasing price ranges, respectively). In contrast, since the treatment was changed to the traditional approach, all participants independently purchased with means of 18.5% for NT$1-NT$100, 9.9% for NT$101-NT$500, and 6.6% for NT$501-NT$1000. Additionally, eight weeks after the removal of the treatment, four participants successfully maintained and generalized the newly acquired skill to four non-trained sites under the support of the MPAS. However, these four participants struggled to maintain the acquired skills, with a mean of 10.6% for the payment, and were incapable of generalizing the independent purchases when they used the traditional one-more-than technique.

Moreover, it was also found that under the intervention of the traditional one-more-than technique, the independent payment performance declined as the price ranges increased (a mean of 18.6 percent for NT$1-NT$100; 9.9 percent for NT$101-NT$500; 6.6 percent for NT$501-NT$1000). In other words, the payment performance was influenced by the prices of items selected by participants. In contrast, for the MPAS approach, four participants’ independent purchases increased
(with a mean of more than 94 percent for the payment) as the price range increased. Besides the payment performance, the number of sessions to reach acquisition criteria also reveal that the higher the price range was, the fewer numbers of sessions required as participants were provided the MPAS (means of 7.25, 7, and 4 for NT$1-NT$100, NT$101-NT$500, and NT$501-NT$1000, respectively). These consistently performed payments indicated that the participants’ correct responses in the MPAS approach were not primarily influenced by the various price range levels, which was diametrically opposed to the effects of the traditional approach. The items’ price would not be the main factors to influence participants’ independent purchase capabilities if they used the MPAS equipped with the one-more-than technique.

The findings in current study also indicated that no matter how the sequence of these two interventions were arranged, the performance of the independent payment was similar: participants failed to acquire the traditional one-more-than technique to make an independent payment, but all of them successfully acquired, maintained, and generalized the purchasing skill through support of the MPAS. These findings also demonstrated that even though participants did not receive any training regarding the money counting skill or the usage of the traditional one-more-than technique, they still could successfully make independent purchases with support of the MPAS.

Finally, in examining the percentage of non-overlapping data between the MPAS intervention and the traditional one-more-than technique, it was found that a 100 percent data point along the correct response rate did not overlap between these two treatments across three price ranges. The effect size in this study was interpreted as a large effect, based on the criteria proposed by Scruggs and Mastropieri (1998): a value of non-overlapping data of greater than 90 percent was classified as a large effect. This finding revealed that a larger positive effect for acquisition of the purchasing skills was found by using the MPAS intervention than through the traditional approach, regardless of the sequence of treatment and various price range levels.

Effects of the Treatment Order, MPAS and Then TOMT

Figure 3 illustrates Luo’s correction percentage of independent payment with use of two types of the one-more-than technique across three price ranges. Luo’s baseline data showed a stable trend of 0 percent with no variability across price ranges. Luo’s independent payment rapidly improved as the MPAS was introduced with means of 90.8% for NT$1-NT$100, 97.8% for NT$101-NT$500, and 99% for NT$501-NT$1000 across two community settings. Luo required 9, 8, and 5 sessions to reach acquisition criteria across various price ranges, respectively. When the treatment was alternated to the traditional approach, the performance dramatically declined to means of 19.6% for NT$1-NT$100, 10.6% for NT$101-NT$500, and 7.8% for NT$501-NT$1000. Additionally, Luo maintained and generalized the newly acquired independent purchasing skills to four non-trained community sites across three price ranges for at least eight weeks after the removal of the instruction under the assistance of the MPAS. Alternately, there were lower maintenance effects (i.e., around 11.7%) and the 0% correction of generalized effects across three price ranges as Luo used the traditional one-more-than technique.

Figure 4 displays Wang’s percentage performance of independent payment with the use of two types of the one-more-than technique across three price ranges. A 0 percent correct response indicated that Wang did not make any independent purchases during the baseline phase. Under support of the MPAS, the correct responses dramatically increased to a mean of 90.5% for NT$1-NT$100, a mean of 95% for NT$101-NT$500, and around 98% for NT$501-NT$1000. Seven, six, and five sessions were required to reach the acquisition criteria across each price, respectively. When the treatment was alternated to the traditional one-more-than intervention, the correct responses dramatically dropped to a mean of around 14% for NT$1-NT$100, a mean of around 7.7% for NT$101-NT$500, and around
7% for NT$501-NT$1000. Eventually, after eight weeks of the removal of the instruction, the newly acquired skills were successfully maintained and generalized to four non-trained community sites under the assistance of the MPAS, whereas only a mean of 5% correction was maintained and no purchases was generalized under the approach of the traditional one-more-than technique.

Effects of the Treatment Order, TOMT and Then MPAS

Figure 5 displays Li’s independent payment percentage performance with the use of two types of the one-more-than technique across three price ranges. Li demonstrated stable performance with a mean of 1.9 percent during the baseline. With the traditional one-
more-than technique implemented, there was a minimal increase to a mean of around 32% for items costing no more than NT$100 dollars, 18% for NT$101-NT$500, and 11% for NT$501-NT$1000. When the treatment was alternated to the MPAS intervention, performance dramatically improved to means of 96% for NT$1-NT$100, 96.8% for NT$101-NT$500, and 100% for NT$501-NT$1000, respectively. Li required 7, 7, and 3 sessions to reach the acquisition criteria across purchase value sets, respectively. Eight weeks after removal of the intervention phase, a striking disparity was evident between these two treat-

Figure 4. Wang’s percentage of correct payment across levels of price.

Note: (a) Supermarket sites: ●: RT-MART, ○: Well-comme, ●: Pay; Convenience stores: ▲: Hi-Life, △: 7-11, □: Family

(b) TOMT referred to the traditional one-more-than technique
ments on the effects of maintenance and generalization. A 100 percent correct performance average across two community settings and various price levels was maintained with the support of the MPAS. Similarly, the independent purchasing skill was generalized with a mean of 100% to four non-trained community sites across three price ranges. Alternatively, a mean of 20.8% was preserved and no generalization was made on independent purchases with use of the traditional one-more-than technique.

Figure 6 demonstrates Zeng’s percentage performance of independent payment with the use of two types of the one-more-than technique across three price ranges. Result for Zeng depicted 0 percent of independent purchasing during baseline. A stable performance with a mean of around 4.26% occurred in the traditional approach, including means of 8.75% for NT$1-NT$100, 3.5% for NT$101-NT$500, and 0.55% for NT$501-NT$1000. When the treatment was alternated to the MPAS intervention, Zeng improved performance with means of 95% at NT$1-NT$100, 98% at NT$101-NT$500, and 100% for
NT$501-NT$1000. For Zeng, 6, 7, and 3 sessions were required to reach the acquisition criteria, respectively. Eight weeks after the completion of the instruction, the purchasing skills were successfully maintained across two community sites and generalized to four non-trained stores with a mean of 100 percent under support of the MPAS. Alternatively, a low correct response percent rate in the maintenance phase and an approximate 0% rate in the generalization phase were identical to that in the intervention phase under the usage of the traditional one-more-than technique.

Analysis of the Error Patterns of the Maintained Newly Acquired Payment Skills under the Traditional One-More-Than Technique

The above findings indicated lower percentage correction of independent purchasing under the traditional approach. Therefore, further analysis of the error patterns of their money counting behaviors, particularly performance after at least eight-week removal of the intervention. Based on the anecdotal records, analysis of payment in the maintenance phase indicated that a 30 percent proportion of the failure could be attributed to “numbers interference.” “Numbers interference” refers to money counting being interfered by the numbers of the price, particularly the second number located on the left side of the price. For instance, if the price was NT$235, normally the procedure of the traditional one-more-than is to prepare two hundred bills for NT$200, then put one more hundred bill for the pile of NT$35. However, according to the records, it was found that participants were likely to prepare a total of five hundred bills: they prepared two NT$100 for the first price number (i.e. 2) and then counted three NT$100 for the second number (i.e. 3). This

Figure 6. Zeng’s percentage of correct payment across levels of price.
kind of “numbers interference” did not occur during the intervention phase. Apart from the “numbers interference”, patterns of payments can be categorized into the following: (a) 31.5 percent for counting by ones (e.g., counting like: 1, 2, 3 . . . as they had several NT$100 bills); (b) 24.5 percent for counting by titles (e.g., prepaying money like this: 100, 100, 100 as they had several NT$100 bills); and (c) 14 percent for other methods (i.e., preferred to pay more than requested). Meanwhile, it was also noted that most participants would look at the instructor with a slight hesitation, or sometimes, they alternatively used the money counting patterns listed above when they prepared money to pay a cashier. Generally, three NT$100 dollars could be counted as: 100, 200, and 300. It also could be counted as: 1, 2, and 3 for a total of 3 NT$100 bills. It could also be counted like this: “this is a hundred dollar, this is a hundred dollar, and all of these are hundred dollars.” As a consequence, it could be said that these error patterns would be regarded as a correct response if they were displayed in the right situation. Moreover, this retrieval of patterns also reflected that the acquired money counting skills had already been stored in participants’ memories, which was not the main barrier to interfere with the usage of the one-more-than technique. The main barrier for the usage of the traditional technique was not largely focused on the formulation of money-counting skills, which was highlighted by Cihak and Grim (2008), but rather the correct situational application, preference of counting out all the money and the price “numbers interference”.

Social Validity

At the end of the study, the four special education teachers, the participants’ parents, and four cashiers who were responsible for at least three sessions were asked to complete a social validity interview. The interview was composed of two open-end interview outlines.

Results from interviews concluded that all teachers, parents, and cashiers considered the effects of the MPAS intervention to be positive for individuals with ID. The statements from teachers and parents can mainly be categorized as: (a) its ease-of-use; (b) lower entry to operate; (c) quick effects and less training time; (d) inducement of confidence for those with ID; (e) smartphones with multiple functions available for daily life. The statements contributed to the positive effects of the MPAS, as compared with the traditional instruction approach, which was deemed to take too much time to enhance math concepts (e.g., money-counting skills) for students with ID.

However, the majority of opinions from cashiers in support of using the MPAS focused on its facilitation of independent purchases for individuals with ID. Such use of the MPAS would effectively reduce the work overloading cashiers, caused by offering too much extra help to their customers. Meanwhile, another issue that concerned the cashiers involved monetary transactions. Could offering extra service related to the transaction of money get the cashiers in trouble? This was a particular concern for those cashiers whose customers could not express their ideas clearly. These concerns may be diminished if those customer populations could independently make purchases through the support of the MPAS.

Finally, all special education teachers expressed their willingness to continue to use the MPAS intervention to train their other students in making independent purchases across other community settings (e.g., bookstores, department stores to purchase clothes, restaurants for lunch or dinner). These teachers would also recommend the MPAS intervention technique to other teachers. Furthermore, the parents of all four participants planned to install the MPAS app inside their children’s smartphones. This would allow the parents to regularly ask their children to make some household-related purchases (e.g., eggs, bread, noodles) at stores near their homes. There are many valid social reasons to employ the MPAS. In addition to its usefulness on ability to make direct purchases, it is interesting to note that the MPAS intervention relieved a great deal of stress from teachers, and it gives parents a newfound hope for their children’s futures. Special education teachers experienced so much disappointment and frustration when their curriculum included conducting training related to daily life for students with ID. Making purchases has often been a tough task for their students to master,
and the results of previous training related to money counting not only disappointed the teachers, but all too often, increased stress levels. Parents worried about their children’s futures based on the endless string of failures related to social functioning training (e.g., using public telephones). The success attained by the children making independent purchases gave parents an unprecedented hope the future.

Discussion

This research was focused on proposing effective modifications of the one-more-than technique feasible for four secondary school students with moderate ID, who had inconsistent money counting behavior and lived in a country demanding high living expense. The findings demonstrated that with the assistance of the MPAS all participants successfully acquired, maintained, and generalized the independent purchase skill across two settings and three levels of price range. However, this study also verified that four participants failed to acquire the traditional one-more-than technique to make independent purchases, particular as the level of price range increased. Therefore, it was concluded that the MPAS approach equipped with the one-more-than technique would be of great benefit than simply using the traditional one-more-than technique.

Findings expand the literature in relation to instructing people with moderate ID making purchases. First, although previous literature indicated that the traditional one-more-than technique was beneficial for supporting individuals with ID to purchase items costing below the capacity of their counting skills, such as $9 (David & Robert, 2008), $9.9 (Ayres et al., 2006), $20 (Gihak & Grim, 2008; Denny & Test, 1995; Test et al., 1993), $35 (Colyer & Collins, 1996) and NT$100 (Wu, 2006), there are no empirical-based studies in relation to making modification of this technique to reach the high daily living expense in Taiwan (i.e., NT$626) for those who did not have good money-counting capacity. This study demonstrated that the MPAS approach would not demand the ability of precisely money counting-on skill and was not strongly influenced by the level of price range. Even though participants were incapable of precisely counting the money to the amount of price that they would buy (i.e., they did not reach the entry of using one-more-than technique), they still could pay the money with using the one-more-than technique under the support of the MPAS.

Second, the usage of mobile devices to support daily life for those with ID has been widely employed in daily life, such as vocations (Burke et al., 2010; Gihak et al., 2008), cooking (Taber-Doughty et al., 2011), communications (Achmadi et al., 2012; Flores et al., 2012; van der Meer et al., 2011), and causal leisure activities (Hammond et al., 2010; Kagohara, 2011). No studies regarding the integration of mobile devices into the procedure of the independent purchases was found, except the planned shopping list (Bouck et al., 2012). The study conducted by Bouck et al. (2012) was more focused on investigating effects of digital audio shopping list (created by a MP3 recorder) on independently obtaining the planned items. But instead, in this current study a mobile device was embedded with the money computing algorithm for the sake of assisting participants with moderate ID to successfully pay money in making independent purchases. Literature regarding the functionality of mobile technologies in supporting people with ID making purchases was expanded from a voice memorandum to a more advanced money counting machine suitable for the payment. Additionally, the mobile device utilized in the study by Bouck et al. (2012) was a MP3 recorder while in the current study the technology instrument was a smartphone, a multi-functional device that combines the features of a telephone with more advanced computing capacities, such as a calculator, a media player, a digital camera, and a GPS navigation service. A smartphone is very popular, not particularly expensive, and more easily connected and integrated into daily life (Hsu, 2014). In other words, carrying a smartphone equipped with the MPAS could be construed as a regular part of life, not particularly for the purpose of this research, making purchases, but meeting this population’s needs to attain and maintain regular lives. Smartphones can be used to make calls, take pictures, play a video game, and listen to music during leisure time.
Third, research has put much emphasis on training regarding formulation of money-counting skills and on effectively etching the acquired skills in memory (Cihak & Grim, 2008). However, analysis of error patterns within the maintenance phase seems to show that the problem does not only exist in the formulation of the counting skills or in the failure of recalling the counting strategies, but rather in the inadequacy of identifying the situation to properly use correct strategies. Thus, although the entry of this technique was money-counting capacity (Hsu, 2014) and the majority of studies centered on the formulating of money-counting skill (Cihak & Grim, 2008; David & Robert, 2008; Denny & Test, 1995), the findings from the current study further suggest that except for training of the counting-on skill, the future training should be more focused on instructing individuals with ID how to pick up an appropriate strategy among several acquired counting skills in order to increase the maintenance effects.

Fourth, although some studies have demonstrated the effectiveness of the payment card strategy (i.e. a credit card, and a debit card, etc.) on helping those with intellectual disability bypass the payment procedure of counting money (Rowe, Cease-Cook, & Test, 2011; Rowe, & Test, 2013), it still has some potential drawbacks; (a) Not all of retail places in Taiwan accept the payment by payment cards (e.g., open markets, groceries etc.) and individuals must still count out real money for the payment, (b) The use of payment cards does not mean acquiring skills of counting out money is not necessary for users. In contrast, there is a necessity for counting money and storing a monetary value on their cards before or after purchases. Because of these potential problems, instructing individual with ID paying by cash should not be abandoned. In this current study the MPAS approach provided an alternative to the independent payment by real money for individuals with moderate ID, particular for purchases costing in the higher level of price range.

Limitations and Future Research

In order to fully interpret and apply the findings from this research, several limitations related to the participants, settings, and perceptions of significant others should be considered. Previous research indicated that IQ scores would influence the performance of the use of information technology for people with ID (Gutiérrez & Martorell, 2011). The IQ scores of participants in this study ranged from 41 to 47. In future studies, individuals with different ranges of IQ scores (e.g., severe intellectual disability or higher ranges of IQ with moderate intellectual disability) should participate in order to investigate the effectiveness and usefulness of the MPAS intervention. In the future, a larger sample size will be needed to increase the external validity and the generalization of this study.

Besides the factor of the participants, the community setting may be another limiting aspect that should be considered in this study. Supermarket and convenience stores are this study’s primary community settings. There are other settings in the participants’ local community, which might influence their daily lives, such as open-air night markets and traditional groceries that featured in making purchases in a rush. Thereby, extending the circumstance would allow future researchers to evaluate the effectiveness of both treatments.

Finally, making purchases was definitely a complex task in relation to visual, auditory, and kinesthetic actions during the procedure of physical shopping activities. Two aspects regarding the multiple representations and physical interaction of information technologies are recommended for future study. First of all, this study mainly aimed to investigate the effect of scaffolding mechanisms of the MPAS as well as a comparison with the traditional approach of one-more-than technique, rather than detail investigating the effects of different types of representations on facilitating independent purchases. Therefore, it is recommended that future research could explore the effects of the different modalities of the representations (i.e., auditory representations, visual representations) on supporting participants in dealing with the different procedure of making purchases. Secondly, as the literature review indicated, numerous studies supported that information technologies could be an appropriate tool for facilitating the learning of individuals with ID on daily
functional skills, such as video modeling or video prompting. Therefore, it is recommended that more advanced technologies, such as physical devices (e.g., Microsoft Kinect), could be incorporated for interacting with the instructional video clips through the channel of participants’ natural physical movements, gestures and voice commands during the training and the application of the MPAS into the procedure of independent purchases.

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Effects of Computer-Based Video Instruction on the Acquisition and Generalization of Grocery Purchasing Skills for Students with Intellectual Disability

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Abstract: The purpose of this study was to evaluate the effects of computer-based video instruction (CBVI) on teaching grocery purchasing skills to students with moderate intellectual disability (ID). Four high school students with mild to moderate ID participated in the study. A multiple-probe design across students was used to examine the effects. Results indicated that using CBVI independently was an effective method for facilitating the acquisition and generalization of grocery purchasing skills by students with ID. The four students in the study acquired and generalized these skills to actual grocery stores. Limitations and suggestions for future research are discussed.

One of the most important skills for students with intellectual disability (ID) is grocery purchasing skills. Morse, Schuster, and Sandknop (1996) stressed the importance of teaching these skills because they are required for the daily lives of the majority of people (Ford et al., 1989) and are directly associated with individuals’ health and nutrition. In addition, these skills provide people with disabilities opportunities to practice other needed life skills (e.g., social skills and money management skills). However, it is unquestionably difficult for special educators to teach these skills to students with ID. There are some reasons for this. First, purchasing groceries requires multiple skills. For instance, individuals need to possess reading skills in order to interpret shopping lists and aisle signage; math skills for calculating purchase totals or change due; and communication skills for greeting others and asking questions. Also, students with ID generally have deficits in cognitive abilities such as memory and short attention span. Limits to such abilities directly impact the acquisition of grocery purchasing skills.

For these reasons, researchers have introduced a variety of systematic interventions and assessed their impact on students with ID grocery purchasing skills. Goo (2013) categorized the interventions in the literature into six types: (1) community-based instruction (Bates, Cuvo, Miner, & Korabek, 2001); (2) classroom simulations (Mores & Schuster, 2000); (3) video technology (Alberto, Cihak, & Gama, 2005); (4) concurrent instruction (Gihak, Alberto, Taber-Doughty, & Gama, 2006); (5) computer technology (Langone, Shade, Clees, & Day, 1999); and (6) computer-based video instruction (Mechling, Gast, & Langone, 2002).

With recent advances in technology, one of the most promising interventions that researchers recommend is computer-based video instruction (CBVI). Computer-based video instruction refers to a method for teaching skills using computers that provide multimedia materials, such as videos, photographs, and auditory components, that simulate real-life environments. Some advantages of using CBVI are that it allows students to experience real-life environments that simulate actual en-
vironments and that it offers various examples and instant feedback (Hutcherson, Langone, Ayres, & Clees, 2004). Video segments embedded in CBVI programs also offer opportunities for students to practice skills via mimicking (Mechling, 2005).

The first study investigating the effects of CBVI on teaching grocery purchasing skills to students with ID was conducted by Wissick and colleagues (1992). Three high school students diagnosed as having mild to moderate ID participated in the study. A multiple baseline design across subjects was used to examine the effects of a video-disc simulation program that taught students how to locate and purchase grocery items. The results demonstrated that video-disc simulation was an effective method for instructing the students in these skills. All students’ performance improved following the intervention.

Mechling and colleagues (2002) conducted the next study evaluating the effects of CBVI. In this study, a CBVI program was used to teach four students with moderate ID how to match grocery item words with category words in aisle signs, and then how to locate target grocery items. A multiple probe design across three sets of word pairs associated with grocery shopping and replicated across the students was used. Entering target aisles and locating target grocery items were used as the dependent variables. Results indicated that CBVI was effective in teaching the skills to this population. All students’ performance on entering the target aisles and locating the target grocery items improved in both CBVI and generalization conditions.

Ayres and Langone (2002) evaluated the effects of using only CBVI to teach grocery purchasing skills by employing a multiple probe design across students. A CBVI program called Dollar Plus was used with a constant time delay (CTD) strategy to instruct three elementary school students with ID. The program presented five sets of dollar amounts that allowed the students to practice paying for groceries using video footage. Paying correctly was used as the dependent variable. Study findings indicated that using CBVI programs independently of other interventions improved student performance in the area of grocery purchasing skills; however, using it alone was insufficient for decisively teaching such skills. None of the students in the study reached mastery level, and the acquired skills were not generalized to actual grocery stores.

Mechling and Gast (2003) conducted a study similar to that of Mechling et al. (2002) that investigated the effects of CBVI on teaching students with ID the location of grocery items. The study used a CBVI program and a CTD strategy to teach the relevant skills, and a multiple probe design across grocery and aisle sign word pairs was used across the students. The findings demonstrated that CBVI promoted the acquisition and generalization of the location of target grocery items by students with ID. All students’ performance improved after the CBVI training. Mechling (2004) also conducted a study that examined whether using CBVI increased the shopping fluency of students with ID. Three students with moderate ID participated, and a multiple probe design across students was used. The study employed a CBVI program and a CTD strategy, and total amount of time to complete locating three grocery items was used as the dependent variable. The results indicated that using CBVI alone was an effective medium to improve shopping fluency, as the amount of time each student took to shop for items decreased.

Ayres, Langone, Boon, and Norman (2006) evaluated the effects of CBVI by teaching the Dollar Plus strategy to four secondary school students with ID using Project Shop software, which was designed to teach this strategy. A multiple probe design across students was used. The CBVI program provided the students with training on how to pay the appropriate dollar amount for groceries. Choosing the correct dollar amount in the program and paying the correct dollar amount at a grocery store were used as the dependent variables. Results of the study demonstrated that using CBVI was an effective tool for teaching this strategy to students with ID. Three of the students acquired the strategy, which was then generalized to the grocery store.

The most recent study of the effects of CBVI was conducted by Hansen and Morgan (2008). In this study, which employed a multiple baseline design across students, three secondary school students with ID were taught grocery purchasing skills using CBVI. The Project Shop software package used by Ayres
et al. (2006) was also used in this study. Five steps required for shopping for grocery items were used as the dependent variables. The findings indicated that using CBVI was an effective medium for teaching these skills to students with ID. The students’ performance considerably improved following the intervention, and all students responded 100% correctly in the generalization condition.

As previously mentioned, research has shown that CBVI is effective in the area of teaching grocery purchasing skills to students with ID. However, in many of the previous studies CBVI was incorporated with other instructional strategies (e.g., prompting systems), rather than being evaluated without the use of other strategies. Therefore, this study sought to determine whether using CBVI alone is an effective method for helping students with moderate ID to acquire these skills, as well as whether the skills acquired through CBVI generalize to actual grocery stores.

Method

Participants

The primary researcher first interviewed a resource room teacher working in a large urban district in South Korea to identify participants. The teacher nominated four high school students diagnosed as having moderate ID. All students were served in a resource room to learn functional academic skills, functional life skills, and job skills. Even though all students had previous experience with learning grocery purchasing skills, they were still struggling with implementing these skills. None of the students had any physical problems that affected their movements.

During the identification process, students’ IEP goals were reviewed to ensure that the purpose of the study was relevant and would assist in meeting these goals. The primary researcher then examined four entry skills required to participate in the study. Those skills included: (a) the present performance level of grocery purchasing skills at an actual grocery store, (b) reading sight words related to grocery purchasing, (c) matching sight words and actual items/pictures, and (d) using a computer mouse (e.g., clicking). Based on the examination of the entry skills, all students participated in the study. Table 1 presents the students’ demographic, academic, and social characteristics.

Instructional Arrangement

Two different settings were used in this study. The first was the students’ special education classroom, which measured approximately 35 ft by 25 ft. The primary researcher’s laptop was placed on a desk in the back of the classroom. The second setting was two national chain grocery stores. One was used as a training grocery store; it was located approximately 20 minutes away from the students’ school. This store was chosen because the students often shopped there for grocery items with their families. The training grocery store was videotaped to create videos embedded in a CBVI program for the study and was also used to collect the students’ performance data in the pre- and post-test conditions. The other was a novel grocery store located approximately 30 minutes away from the school that was used to examine whether the skills acquired through CBVI would be generalized to a novel grocery store. This store was used to collect the students’ performance data in the generalization condition. No information about this store was provided during the intervention condition.

Materials

Equipment. An HP Pavilion g series laptop was used to deliver the CBVI intervention and to collect data through a computer-based assessment (CBA) program during the baseline and intervention conditions. A CANON EOS 5D Mark III digital camera was used to create videos and photographs embedded in the CBVI program. SONY Vegas pro 11.0 software and Adobe Photoshop CS5 were used to edit the videos and photographs. Adobe Flash Professional CS5 software was used to create the CBVI and CBA programs.

Photographs. Three target grocery items and one distracting grocery item were photographed. In addition, three target aisle signs and one distracting aisle sign were photographed. These photographs were edited and
embedded in the CBVI and CBA programs as potential answers to questions.

Target grocery items. Based on the curriculum of the resource room, the special education teacher identified three specific grocery items (e.g., “Richam” - a brand of canned meat) for the study. Each item was chosen from different aisles.

Checklist for data collection. A checklist for grocery purchasing skills was used for data collection during the pre- and post-test and generalization conditions. The checklist included participant name, data, location, observer, session, score, start time, end time, duration, the steps of grocery purchasing skills, allotted time, and check boxes.

Video clips. Seventeen short videos teaching each step of grocery purchasing skills were created and embedded in the CBVI program. The primary researcher first wrote scripts for each video and then hired an actor to create the videos. While filming, the actor pretended to be a shopper at the training grocery store and acted out key behaviors and information related to each step. If needed, a close-up technique was used to provide students with details of the key behaviors in the videos. Each video was approximately 10-20 seconds long.

Computer-based video instruction program. The primary researcher developed the CBVI program to teach grocery purchasing skills. The program consisted of a title screen (the first screen), virtual shopping screen (the second screen), and short instructional video and question screens for 17 steps of grocery purchasing skills. Except for the first two screens, screens for each step included one video and one question screen. First, a screen presenting a video for a step would appear; it was followed by a screen presenting a question related to the video. This pattern continued until the last step. In addition, the CBVI pro-

<table>
<thead>
<tr>
<th>Student</th>
<th>Age</th>
<th>Disability</th>
<th>IQ</th>
<th>Strengths and Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mike</td>
<td>17 yrs 2 m</td>
<td>ID</td>
<td>KISE-KIT. 44</td>
<td>Academically, he could read sight words associated with grocery purchasing and solve simple addition and subtraction problems. Socially he was very friendly and liked to work with classmates.</td>
</tr>
<tr>
<td>John</td>
<td>18 yrs</td>
<td>ID</td>
<td>K-WISC III. 55</td>
<td>Academically, he could read sight words associated with grocery purchasing skills and calculate simple addition and subtraction problems containing regrouping. He displayed mild articulation problems, which might cause communication problems. Socially, he often wanted to be alone and tried not to make eye contact.</td>
</tr>
<tr>
<td>Don</td>
<td>18 yrs</td>
<td>ID</td>
<td>K-WISC III. 47</td>
<td>Academically, he could read basic sight words and write simple spelling words and could also calculate two-digit math problems. He was familiar with using a computer. Socially, he was likely to be nervous about unfamiliar situations.</td>
</tr>
<tr>
<td>Jason</td>
<td>18 yrs</td>
<td>ID</td>
<td>K-WISC III. 55</td>
<td>Academically, he was able to read simple sentences and solve simple two-digit addition and subtraction problems. He had some behavioral problems such as easily getting upset and repeating phrases. Socially, he had problems with initiating conversations with other people.</td>
</tr>
</tbody>
</table>

Note. KISE-KIT = Korea Institute for Special Education-Korea Intelligence Test for Children; K-WISC III = Korea-Wechsler Intelligence Scale for Children III.
gram provided students with visual/auditory feedback and prompts to guide them through the steps.

*Computer-based assessment program.* The primary researcher also developed a CBA program to collect data during the baseline and intervention conditions. This program was similar to the CBVI program. While it did not present any videos or visual/auditory feedback and prompts, it did present the same questions as the CBVI program.

**Experimental Design**

A multi-probe design across students (Kazdin, 1982) was employed in this study. First, a pre-test condition took place to measure the students’ present performance level at the training grocery store. Baseline and intervention conditions then took place sequentially. During the baseline condition, the CBA was used to collect data on the students’ present knowledge about performing grocery purchasing skills. During the intervention condition, first the CBVI program was used to teach grocery purchasing skills, and then the CBA program collected data on the students’ progress. Following the intervention condition, a post-test condition took place to measure students’ progress at the training grocery store, and then a generalization condition took place to determine if the skills acquired through the CBVI program were generalized to a novel grocery store.

**Dependent Variables**

Steps to perform grocery purchasing skills were used as the dependent variables. The steps were adopted and modified from Mechling and colleague’s (2002) study. Seven steps necessary for purchasing one grocery item were used to collect data in the current study. The steps were as follows: (1) getting a shopping cart, (2) entering an aisle, (3) obtaining a target item, (4) placing the target item in the shopping cart, (5) crossing out the target item obtained on the shopping list, (6) returning to the entrance of the aisle, and (7) reaching a checkout stand. Steps 2 through 5 were then repeated in order to locate a total of three grocery items. Therefore, a total of 17 steps were used as the dependent variables across all settings (e.g., grocery store and classroom settings). However, although the same steps were used across settings, the definitions of these steps differed based on the conditions. For example, during the baseline and intervention conditions (classroom settings), the definition of Step 1 was “Obtaining a shopping cart.” On the other hand, during the pre-and post-test and generalization conditions, the definition of Step 1 was, “Completion of getting a shopping cart and starting to push the cart toward the aisles within 20s after the researcher’s direction to start shopping.” See Table 2 for dependent variable steps.

**Procedure**

*Pre- and post-test conditions.* The primary researcher took the students to the training grocery store, which was later used as the model store in the CBVI program. The primary researcher brought one of the students to the entrance of the grocery store while an assistant took care of the rest of the students at a rest area outside the store. The primary researcher gave the student a clipboard holding a shopping list and the direction to “begin shopping,” and then followed the student with an inter-observer to collect data. If the student did not complete a step, the primary researcher completed the step and guided the student to the next step by giving the direction, “What is the next step?”

*Baseline condition.* The baseline condition occurred after the pre-test condition. This procedure was individually conducted with each student. After a student began the procedure, it continued until the student’s data became stable. Three or four sessions were given to each student per week; each session was approximately 5 minutes long. During the baseline condition, the CBA program was used to measure the students’ knowledge of grocery purchasing skills (i.e., the steps necessary to perform grocery purchasing). The primary researcher ran the CBA program and pulled up the first screen (title screen) before the student arrived. After the student entered the classroom, the researcher had the student sit in front of the laptop and then sat by the student and gave the direction, “If you are ready to start this computer program, click on the ‘Start’ button in the middle of the screen.”
In each session, the student was asked 17 multiple-choice questions through the CBA program that were related to each step of purchasing three grocery items. A virtual shopping list with a voice recording (i.e., “This is the shopping list for today.”) was provided in the second screen, and the student clicked on an arrow button on the screen to move forward to the next screen, which presented the first question. While the questions were asked, a virtual shopping list presenting the three grocery items was visible in the top right corner of each screen. This allowed students to view the shopping list throughout the session. The grocery items and the sequence of these items on the virtual shopping list were exactly the same as on the shopping list used during the pre- and post-test and generalization conditions.

Each question corresponded to each step of the grocery purchasing skills and dealt with the correct behavior required to complete

<table>
<thead>
<tr>
<th>Step</th>
<th>Dependent Variable</th>
<th>Definition of Correct Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Obtaining a shopping cart</td>
<td>Completion of getting a shopping cart and starting to push the cart toward the aisles within 20s after the researcher’s direction to start shopping</td>
</tr>
<tr>
<td>2</td>
<td>Entering the first correct aisle</td>
<td>Completion of passing under the correct overhead aisle sign with the shopping cart within 120s after the completion of Step 1</td>
</tr>
<tr>
<td>3</td>
<td>Obtaining the first grocery item on the shopping list</td>
<td>Completion of holding and lifting the target item within 40s after the completion of Step 2</td>
</tr>
<tr>
<td>4</td>
<td>Putting the obtained grocery item in the shopping cart</td>
<td>Completion of putting down the obtained item in the shopping cart within 15s after the completion of Step 3</td>
</tr>
<tr>
<td>5</td>
<td>Crossing out the obtained grocery item on the shopping list</td>
<td>Completion of crossing out the obtained item on the shopping list with a pencil within 15s after the completion of Step 4</td>
</tr>
<tr>
<td>6</td>
<td>Returning to the entrance of the aisle</td>
<td>Completion of placing the cart at the end of the aisle (either side) within 20s after the completion of Step 5</td>
</tr>
<tr>
<td>7</td>
<td>Entering the second correct aisle</td>
<td>Completion of passing under the correct overhead aisle sign with the shopping cart within 40s after the completion of Step 6</td>
</tr>
<tr>
<td>8</td>
<td>Obtaining the second grocery item on the shopping list</td>
<td>Completion of holding and lifting the target item within 40s after the completion of Step 7</td>
</tr>
<tr>
<td>9</td>
<td>Putting the obtained grocery item in the shopping cart</td>
<td>Completion of putting down the obtained item in the shopping cart within 15s after the completion of Step 8</td>
</tr>
<tr>
<td>10</td>
<td>Crossing out the obtained grocery item on the shopping list</td>
<td>Completion of crossing out the obtained item on the shopping list with a pencil within 15s after the completion of Step 9</td>
</tr>
<tr>
<td>11</td>
<td>Returning to the entrance of the aisle</td>
<td>Completion of placing the cart at the end of the aisle (either side) within 20s after the completion of Step 10</td>
</tr>
<tr>
<td>12</td>
<td>Entering the third correct aisle</td>
<td>Completion of passing under the correct overhead aisle sign with the shopping cart within 40s after the completion of Step 11</td>
</tr>
<tr>
<td>13</td>
<td>Obtaining the third grocery item on the shopping list</td>
<td>Completion of holding and lifting the target item within 40s after the completion of Step 12</td>
</tr>
<tr>
<td>14</td>
<td>Putting the obtained grocery item in the shopping cart</td>
<td>Completion of putting down the obtained item in the shopping cart within 15s after the completion of Step 13</td>
</tr>
<tr>
<td>15</td>
<td>Crossing out the obtained grocery item on the shopping list</td>
<td>Completion of crossing out the obtained item on the shopping list with a pencil within 15s after the completion of Step 14</td>
</tr>
<tr>
<td>16</td>
<td>Returning to the entrance of the aisle</td>
<td>Completion of placing the cart at the end of the aisle (either side) within 20s after the completion of Step 15</td>
</tr>
<tr>
<td>17</td>
<td>Reaching a checkout counter</td>
<td>Completion of placing the cart in a line or in front of a cashier within 80s after the completion of Step 16</td>
</tr>
</tbody>
</table>
that step (e.g., “Using the aisle signs, what aisle would you go to in order to get the first item on your shopping list?”). Each question included one correct and three incorrect answers. These answers appeared as either text or photographs based on the steps. For instance, the answers to Step 2 were written (e.g., “b. Get a shopping cart.”), while the answers to Step 3 were photographs of grocery items. As each question was presented on the screen, a voice recording read the question aloud. However, the possible answers to the question were not provided until the voice recording had finished so that the students would have the same amount of time (i.e., 10s) to answer each question regardless of the length of the recording. The CBA program advanced to the next question after 10 seconds irrespective of whether or not a student responded to the question. During the CBA sessions, no prompts were given to students except for neutral praise (e.g., “good job”) after completing the program.

Correct and incorrect responses were scored as one point and zero points, respectively. Thus, the total possible points for each session was 17. The final score of each session was automatically scored and presented as a percentage on the final screen of the CBA program, and the percentage was recorded on the score sheet. After the first student showed stable data points (i.e., three consecutive data points in a row), the student moved on to the intervention condition. The same procedures were then applied to the remaining students. While each student was involved in the intervention, the CBA was intermittently given to the rest of the students in order to collect baseline data. These intermittent measures were conducted 1-2 times per week.

**CBVI condition.** During the CBVI condition, the primary researcher delivered the CBVI intervention to each student. It was approximately 15 minutes long and was given to the students 1-2 times a day based on their classroom schedules. Each CBVI session consisted of two parts: (a) teaching grocery purchasing skills (i.e., CBVI), and (b) measuring students’ progress (i.e., CBA). The primary researcher had students sit in front of the laptop and then gave the same direction used in the baseline condition for the student to begin the CBVI program. The CBVI program presented 17 short instructional videos depicting each step of grocery purchasing skills. After each video, the same question used in the CBA was asked to ensure student’s acquisition of each step. Unlike the CBA, however, the CBVI program presented the questions and possible answers simultaneously.

The CBVI program also provided auditory prompts based on the students’ choices. For instance, if a student chose the correct answer to a question, auditory and visual praise (i.e., “Good job.”) was given through the program. Similarly, if a student chose an incorrect answer, auditory and visual prompts (i.e., “Try again.”) were given. In addition, if a student did not begin to choose an answer within the allotted time (i.e., 10s), the program automatically provided an auditory prompt (i.e., “What is the correct answer?”), and if the student still did not choose an option within the new allotted time (10s), the primary researcher gave a verbal and gestural prompt to choose the correct answer (i.e., “The correct answer is ______,” pointing out the correct response) and then had the student advance to the next screen by clicking the arrow button (i.e., “Can you click the arrow button?”).

The program automatically scored the students’ responses and presented the final scores on the final screen. However, these scores were not considered dependent measures. After the CBVI intervention, the CBA program was used to measure student progress. The same procedures used in the baseline condition were used for these measures. Task completion criterion was 82.4% (i.e., 14 points) or above for three consecutive sessions. Once the first student met the criterion, the CBVI intervention was stopped for that student. The next student then began the baseline condition. The same procedures were implemented for the rest of the students in turn.

**Generalization condition.** Following the post-test condition, the primary researcher took the students to a novel grocery store that was not presented in the CBVI program. The same procedures adopted in the pre- and post-test conditions were used to collect data in the generalization condition.
Inter-Observer Reliability

The special education teacher and a graduate student collected data for inter-observer reliability at the grocery stores. During the baseline and intervention conditions, data were not collected because this function was automatically performed by the programs. Before the data collection started, the primary researcher trained the graduate student and special education teacher. This data collection occurred across all sessions of grocery store settings. A point-by-point agreement method (Kennedy, 2005) was used to calculate inter-observer agreement. Results of inter-observer reliability were as follows: inter-observer agreement of the pre-test condition was 100%, inter-observer agreement of the post-test condition was 97.8%, and inter-observer agreement of the generalization condition was 100%. Overall, the mean of inter-observer agreement across the conditions was 98.9%.

Procedural Fidelity

Data for determining procedural fidelity were collected. Before the CBVI intervention began, the special education teacher and graduate student were trained to observe the implementation of the CBVI intervention. Data were collected in 50% of the sessions of the CBVI intervention condition across the students. The total number of correct steps of the implementation was divided by the total number of steps so as to calculate the procedural fidelity, and then the results were multiplied by 100. The mean of procedural fidelity across all students was 100%.

Results

Figure 1 provides a visual representation of the students’ performances across all conditions. During the pre-test condition, Mike correctly performed 11.8% of the steps of grocery purchasing skills at the training grocery store. During the baseline condition, the mean of his correct responses was 49.0% (range 47.1%–52.9%). After his data points became stable, the CBVI intervention began. His correct response mean was 94.1% (range 88.2%–100%) during this condition. Mike showed immediate improvement in his performance and met the task completion criterion in the third session. During the post-test condition, his mean performance was 79.4% at the training grocery store (range 70.6%–88.2%). As compared to the pre-test condition, his performance improved by 67.6%. During the generalization condition, he performed 52.9% of the steps correctly at the novel grocery store.

John performed 17.6% of the steps correctly at the training grocery store during the pre-test condition. During the baseline condition, his correct response mean was 42.6% (range 35.3%–52.9%). During the intervention condition, his correct response mean was 100.0% (range 100%). His performance improved in the first session and he met the task completion criterion in the third session. During the post-test condition, like Mike, John’s performance also improved at the training grocery store. His mean performance was 94.1% (range 94.1%). As compared to the pre-test condition his performance improved by 76.5%. During the generalization condition, he performed 58.8% of the steps correctly at the novel grocery store.

Don performed 0% of the steps correctly at the training grocery store during the pre-test condition. During the baseline condition, his correct response mean was 25.9% (range 17.6%–29.4%). Following the baseline condition he received the CBVI intervention. His improvement was not as quick as the first two students but it did gradually improved and he met the task completion criterion in six sessions (range 17.6%–100%). The correct response mean was 73.5% (range 17.6%–100.0%). During the post-test condition, Don’s mean performance was 76.5% (range 70.6%–82.4%). As compared to the pre-test condition, his performance improved by 76.5%. During the generalization condition, he performed 70.6% of the steps correctly at the novel grocery store.

Jason performed 0% of the steps correctly at the training grocery store during the pre-test condition. During the baseline condition, his correct response mean was 17.6% (range 17.6%). After the intervention began, his performance rapidly improved and he met the task completion criterion in the fourth session. The mean of his correct responses was 86.8% (range 64.7%–100%). During the post-
test condition, his mean performance was 55.9% (range 52.9%–58.8%). As compared to the pre-test condition, he improved by 55.9%. During the generalization condition, he conducted 64.7% of the steps correctly at the novel grocery store.

Discussion
This study examined whether CBVI is an effective method for helping students with moderate ID to acquire and generalize grocery purchasing skills. These findings are congruent with the current literature that overall CBVI alone is effective in teaching such skills to this population (Mechling et al., 2002). All students acquired the target skills through the CBVI program, and the skills acquired were generalized to the training and novel grocery stores. With respect to the acquisition of grocery purchasing skills, the students’ present knowledge of the skills (e.g., required steps)
was measured during the baseline condition, and the mean performance level was 32.1%. Following the CBVI intervention, student performance levels significantly improved and reached the criterion relatively quickly. In the final session, all students’ performance reached 100% of correct responses. Regarding generalization to actual grocery stores, the students’ initial mean performance at the training grocery store during the pre-test condition was 7.4%, but after the intervention that mean improved to 72.8% during the post-test condition. Furthermore, the mean of the students’ performance was 61.8% at the novel grocery store. Even though this performance was not as high as the level of the post-test condition, with the consideration that the store was not presented during the intervention, this was quite a strong finding.

The findings of this study also support the use of multimedia to help students with ID acquire and generalize grocery purchasing skills (Langone et al., 1999; Mechling, 2004). It is not possible to pinpoint which multimedia component (e.g., video clips, photographs, or audio prompts) led to the improvement in the students’ performance; however, it is evident that the combination of these components resulted in improvement. The CBVI program provided photographs, video, and audio recordings, presenting high-quality representations of real world situations. The combination of these multimedia components may have increased the possibility of acquiring the skills and the generalization to the actual grocery stores (Langone et al., 1999).

Additionally, study results may indicate that providing multiple examples facilitate the acquisition and generalization of grocery purchasing skills for students with ID (Mechling et al., 2002). The CBVI program presented multiple examples and non-examples (e.g., correct grocery items and incorrect grocery items) to the students. It allowed the students to be repeatedly exposed to the examples and non-examples. Providing these multiple examples might have enhanced students’ ability to acquire and maintain their skills.

Finally, the results of this study also add to the present literature by suggesting that using CBVI programs that contain interactive components may facilitate the acquisition and generalization of grocery purchasing skills (Mechling et al., 2002; Wissick et al., 1992). During the intervention, students were required to click answers using a computer mouse. Furthermore, feedback or prompts were provided based on their responses (e.g., “Good job.”; “What is the correct answer?”). Including such interactive components in CBVI programs might result in better learning outcomes.

**Limitations**

There were three limitations of this study. First, the results of the study support the contention that CBVI is an effective medium for teaching grocery purchasing skills; however, the acquired skills were limited to purchasing three grocery items that had been modeled through the CBVI program. How well the program would work if more items were purchased and/or if the item list varied each time students went to the grocery store remains to be answered. Second, the students performed the skills like normal shoppers during the actual grocery conditions. This resulted in some real life distractions affecting the students’ performance. For instance, other shoppers blocked their access to target items while the students were locating groceries. In addition, the location of one target item was changed during the study (i.e., moved to a different aisle), and this led to a student’s incorrect responses. Although a limitation, these types of events occur often during trips to grocery stores and so they likely should be incorporated into grocery store CBVI programs in the future. Third, a limited number of measurements were taken during the actual grocery conditions to examine the generalization of the acquired skills. Two sessions during the post-test condition took place to examine the generalization of the acquired skills to the training grocery store, which was videotaped for the CBVI program, and one session took place to examine the generalization of the acquired skills to the novel grocery store, which was not videotaped for the CBVI program. Future studies should collected more data in post-test and generalization conditions.
Suggestions for Future Research

First, researchers should study what constitutes the most effective combination of multimedia components in CBVI programs (e.g., video and photographs, video and text, or video only) for teaching life skills to students with ID. Simply providing various multimedia components may not always positively affect the acquisition and generalization of these skills, and may in fact prove distracting (e.g., providing too many components). Therefore, the best combinations of components for facilitating learning experiences should be examined closely. Second, researchers should investigate the effects of CBVI including tablet computers and their applications. Researchers and practitioners in special education assume that using tablets may be very effective; however, currently only a few studies examine their impact on teaching life skills to students with ID.

Conclusions

This study demonstrated that overall CBVI alone is an effective instructional method through which to teach grocery purchasing skills to students with moderate ID. The multimedia components (e.g., videos and pictures) of CBVI motivate students to actively engage in learning and results in the acquisition and generalization of grocery purchasing skills. Essential components of effective CBVI programs likely include providing multiple examples (e.g., examples and non-examples) and infusing interactive components (e.g., clicking and immediate feedback on students’ responses).

References


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Effects of a Peer-Mediated Intervention on Social Interactions of Students with Low-Functioning Autism and Perceptions of Typical Peers

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Abstract: Students with autism display challenges acquiring friendships and participating in relationships with typical peers. Social interaction is further impacted in students with low-functioning autism, necessitating consideration of their unique characteristics when designing and implementing interventions. This single-subject study examined the effects of a peer-mediated intervention on initiations and responses of four K-2 students with low-functioning autism and their second-grade peers. Students were taught a shared reading intervention using visual support, role-play, discussion, and peer reinforcement. Three participants with low-functioning autism increased mean responses to peer initiations from baseline to intervention stages. Further, second-grade students held positive perceptions of peers with autism and considered them as friends. The unexpected response pattern of one participant with low-functioning autism warrants further investigation into individual variation and peer group characteristics.

Autism is defined as a spectrum disorder characterized by deficits in social communication and social interaction (DSM-V, 2013). Consequently, students with autism often incur significant challenges with acquiring friendships and participating in ongoing relationships with typical peers (Owen-DeSchryver, Carr, Cale, & Blakeley-Smith, 2008). Even when physically included with general education peers, students with autism may be socially excluded because of limited social skills and peculiar mannerisms. Many of these students display very narrow interests, struggle with understanding the social nuances of peer interactions, misinterpret what is being said, and fail to engage in the give and take of conversation, all of which limit their acceptance by typical peers (DiSalvo & Oswald, 2002).

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Inclusion

Including students with autism with typical students is important to supporting their overall social development. Research indicates that learners with autism in inclusive settings benefit from increased opportunities to engage with appropriate peer models and demonstrate improved adaptive behavior (Boyd, Conroy, Asmus, & McKenney, 2011; Lyons, Cappadocia, & Weiss, 2011). However, inclusion by itself may not necessarily lead to social competence. Conflicting research suggests the physical presence of typical peers is not enough to promote appropriate peer interactions for students with autism (Bass & Mulick, 2007; DiSalvo & Oswald, 2002). These learners may not attend to peers and engage appropriately without specific strategies in place. Students with autism in inclusive settings who participate in interventions incorporating modeling and reinforcement have shown more improvement in social skills than similar students with no specific intervention in place (Harper, Symon, & Frea, 2008; Kamps et al., 2002). Thus, providing students with autism with appropriate interventions is important to improving outcomes and reducing social isolation.
Social Profiles of Students with Low-Functioning Autism

To date there has been little research on the social profiles of students with low-functioning autism (LFA; IQ < 80), though social skills of these students are thought to be less well-developed than students with high-functioning autism (HFA; IQ ≥ 80) and indicative of more social deficits even after intensive intervention (Ben-Itzchak & Zachor, 2007; Walton & Ingersoll, 2013). Most students with autism are challenged by social interaction, however the social profiles of students with LFA can be quite different than those with HFA. Compared to students with HFA, students with LFA typically display more stereotypical and self-injurious behavior, are more resistant to change, show less emotional expression and generally show fewer improvements in social skills over time (Mayes & Calhoun, 2011; McGovern & Sigman, 2005). Additionally, social opportunities for students with LFA are often impeded by their limited communication skills even when verbal language is present. Students with LFA have been shown to engage in fewer communicative acts for interaction or joint attention and more for behavior regulation than students with HFA (Maljaars, Noens, Jansen, Scholte, & Van Berckelaer-Onnes, 2011). Consequently, students with LFA may need social interventions that are less complex, target initiations and responses, and reinforce appropriate behaviors.

Peer-mediated Interventions

Peer-mediated interventions are promising interventions that teach typical peers how to interact with students with autism; the peers become the intervention agents, modeling and reinforcing appropriate social behavior for the students with autism (Odom & Strain, 1984). Peer-mediated interventions are grounded in the framework of Vygotsky’s sociocultural theory (Vygotsky, 1978), where learning takes place through the social interactions of the student with autism and the more capable, typical peer who scaffolds and reinforces the development of appropriate social skills. Such interventions have been used successfully to increase social interactions between students with autism and typical peers across a variety of settings (Morrison, Kamps, Garcia, & Parker, 2001; Odom & Strain, 1986).

Many peer-mediated interventions rely on specially chosen typical peers, however students with autism need opportunities to interact with a variety of individuals. Laushay and Heflin (2000) successfully used a class-wide approach and included all members of a class, but few other studies have included a wide range of peers.

Most peer-mediated interventions have been conducted during relatively unstructured activities such as lunch and recess with few studies examining interventions within academic activities in the classroom. Yet at least one study including an academic component resulted in greater social skill outcomes than free-play interventions (Kamps et al., 2002). The structure of the academic activity may have supported increased opportunities for social interaction between the individuals with autism and the typical peers. Further investigation into peer-mediated interventions incorporating an academic activity is warranted.

Shared Reading

Shared reading interventions have been used to support the development of reading and social skills in typical students by encouraging social interactions around a story. Research suggests that these activities provide typical students with an opportunity to improve reading skills, such as fluency, vocabulary, and comprehension while also supporting the development of social skills, such as turn-taking and interacting with peers (Brown, 2006; Flint, 2010; Lowery, Sabis-Burns, & Anderson-Brown, 2008). As students engage in the give and take of shared reading they exchange ideas and experiences related to the story. These shared reading activities support the development of reciprocal relationships between the buddies that extend beyond the classroom reading setting (Lowery et al., 2008). Expanding shared reading activities to include participants with autism can provide needed structure for social interactions and increased opportunities for friendship development.
Typical Peer Perceptions

Findings from several studies indicate that typical students enjoy activities with their peers with autism (Carter, Hughes, Copeland, & Breen, 2001; Jones, 2007). Typical students indicate they feel good about helping their peers and they develop an appreciation of diversity to which they previously had little exposure. However, few of these studies have examined the quality of the relationship between the typical peer and the student with autism, especially in interventions aimed at students with LFA (Owen-Deschryver et al., 2008; Rogers, 2000). Examining the peer relationship is important to understanding the success of the intervention overall and to understanding how peer-mediated interventions may improve long-term outcomes of students with autism.

The purpose of this study was to examine the effects of a class-wide peer-mediated shared reading intervention on the social interactions of K-2 students with LFA and their second-grade typical peers. The perspective of the typical peers and the quality of the relationship between the peers and the students with LFA were examined for social validity and evidence of emerging friendship. The study addressed the following research questions:

1. What is the effect of a class-wide peer-mediated social skills intervention on the social interactions, as measured by initiations and responses, of students with low-functioning autism and typically-developing peers?
2. What are the perceptions of typically-developing second-graders toward their peers with low-functioning autism, and the quality of the relationship?

Method

Participants and Setting

The study took place at a mid-size public elementary school in a suburban area of Northern California. The school serves over 600 students from preschool to fifth grade, including students with LFA and students with moderate to severe disabilities in several self-contained special education classes.

The participants included a class of 24 second-graders and a special education class of eight K-2 students with LFA. The students with LFA ranged in age from five to eight years old, qualified for special education services for autism per the California education code definition, and were identified as a student with LFA (IQ < 80) using the Childhood Autism Rating Scale, second edition (Schopler, Van Bourgondien, Wellman, & Love, 2010), and a measure of intellectual functioning administered by a licensed school psychologist. (See Table 1 for further descriptions of participants with LFA). The second-grade students ranged in age from seven to eight-years old, and included 14 boys and 10 girls comprised of White (71%), Asian (25%), and Hispanic (4%) ethnicities. One second-grade student was a student with a learning disability, and one second-grade student was an English language learner.

All students in both classes participated in the study. Students were randomly placed in eight shared reading groups and stayed with this group for the duration of the study. Each group had one student with LFA and three second-grade typical peers. Four of the shared reading groups were selected for data collection purposes based on parental consent.

Materials

An abundance of books were available in the special education classroom for use during the shared reading intervention. The books were common to early literacy classroom libraries and included popular titles such as Brown Bear, Brown Bear (Martin, 1967), and The Very Hungry Caterpillar (Carle, 1994), as well as alphabet books, counting books, and farm theme books. Books were placed in plastic boxes and arranged on the tables to allow easy access for the students. Teachers made sure there were books available for a variety of student interest and reading levels.

Independent Variable

The independent variable was a peer-mediated shared reading intervention designed to enhance social interactions among the students with LFA and their typical peers. The Reading Buddies intervention had a peer-reading component and a peer-reinforcement component. Centering the intervention on shared reading was important because it in-
corporated an activity that all of the students with LFA enjoyed, encouraged social interaction related to the story, and was an academic activity in which most children would regularly participate. Additionally, incorporating the semi-structured activity of shared reading allowed the typical second-graders to scaffold initiations and responses of their peers with LFA, in a way that would likely not be present in an unstructured free play activity.

For the peer-reading component, two teachers (one general education and one special education) and the researcher instructed students to follow three rules during the intervention phase of the study: Stay with your buddy, Read with your buddy, and Talk with your buddy. The teachers and the researcher modeled the steps of the intervention, engaged students in discussion (e.g. “What does it mean to stay with your buddy?” and “How might we talk with our buddy about the book?”), and called upon students to role-play the steps of the intervention (e.g. “Who can show me what it looks like to read with their buddy?”) A chart displayed the steps of the intervention to increase comprehension for all students (see Figure 1). Teachers instructed students to take turns reading their

<table>
<thead>
<tr>
<th>Student</th>
<th>Language Skills</th>
<th>Reading Skills</th>
<th>Interaction Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caleb</td>
<td>1-3 word phrases</td>
<td>Reads 10 sight words</td>
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</tr>
<tr>
<td>Male</td>
<td>Did not initiate social conversations</td>
<td>Named pictures</td>
<td>Rarely acknowledged peers</td>
</tr>
<tr>
<td>Cauc 2nd Gr</td>
<td>Enjoyed books</td>
<td>Avoided peers on playground</td>
<td></td>
</tr>
<tr>
<td>Jack</td>
<td>1-3 word phrases</td>
<td>Reads 20 sight words</td>
<td>Did not initiate with peers</td>
</tr>
<tr>
<td>Male</td>
<td>iPad for backup communication</td>
<td>Named pictures</td>
<td>Did not acknowledge peers</td>
</tr>
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<td>Cauc 2nd Gr</td>
<td>Enjoyed books</td>
<td>Often walked over peers</td>
<td></td>
</tr>
<tr>
<td>Mary</td>
<td>iPad for communication</td>
<td>Reads 20 sight words</td>
<td>Did not initiate with peers</td>
</tr>
<tr>
<td>Female</td>
<td>Requested food and drink with prompt</td>
<td>Named pictures</td>
<td>Did not acknowledge peers</td>
</tr>
<tr>
<td>Cauc 2nd Gr</td>
<td>Enjoyed books</td>
<td>Avoided peers on playground</td>
<td></td>
</tr>
<tr>
<td>Thomas</td>
<td>1-3 word phrases</td>
<td>Reads alphabet</td>
<td>Did not initiate with peers</td>
</tr>
<tr>
<td>Male</td>
<td>Adult prompting to indicate wants</td>
<td>Named pictures</td>
<td>Did not acknowledge peers</td>
</tr>
<tr>
<td>Asian K</td>
<td>Did not initiate social conversation</td>
<td>Enjoyed books</td>
<td>Avoided peers on playground</td>
</tr>
</tbody>
</table>

Figure 1. Poster of three-step intervention.
books but it was left up to each group to determine who would go first, second, etc. When teachers concluded their discussion, all students chose a book from any of the available books and sat together with their groups. The peer reading lasted 15 minutes with students taking turns reading their books every few minutes. Most books were completed in about 5 minutes.

For the peer-reinforcement component, the students rewarded each other for appropriate behavior. As part of their classroom program the students with LFA used an individualized token economy in which they earned “happy faces” throughout the day for appropriate behavior, and then exchanged the happy faces for rewards (e.g. small edible, hug, high five). During the Reading Buddies intervention, the second-grade students reinforced the students’ with LFA using these same happy face cards. The teachers and researcher instructed the second-grade students in how to use the cards and elicited several examples from the students of what a good buddy might do to earn a “happy face.” Students were not told specifically when to give the happy faces, but rather they decided on their own when their peer was being a “good buddy”. Most groups settled into a routine of giving the happy face at the end of each book (i.e. every three to five minutes), which seemed to be a naturally occurring break for the participants.

Each group was given a marker to make the happy faces and the student with LFA carried his/her own “happy face” card. Once the card was full (i.e. three happy faces) the student with LFA exchanged it for his/her reinforcement, which usually occurred at the end of the session. In return, the students with LFA reinforced their reading buddies by giving them praise, hugs, high-fives, or a sticker at the end of the session (with verbal prompting if needed).

Dependent Variable

The dependent variable in the study was the students’ with LFA and the typical peers’ initiations and responses towards each other. Initiations and responses were chosen as a means to examine social interaction between participants and is widely supported in the literature (Owen-DeSchryver et al., 2008). Initiations were defined as any appropriate motor or vocal behavior demonstrated by the students to gain attention or a response from another student, including verbalizing to another student, looking at another student’s face, touching the other student (e.g., tapping shoulder, touching hand), presenting the book to another student, and pointing to a picture in the book while looking at the student. Responses were defined as any appropriate motor or vocal behavior demonstrated by the students that was preceded by an initiation and occurred within 10 seconds of the initiation including looking at the other student’s face, verbalizing to the other student, smiling at the other student, touching the other student, and giving a motor response such as nodding head or touching a picture in the book.

Data Collection

During the 15-minute shared reading intervention, initiations and responses were measured simultaneously on all target groups every session, using trained data collectors. Observation and recording took place for two minutes, followed by a 30-second break in which no recording took place, and repeated until 10 minutes of data had been recorded for each group. At the end of the 10 minutes of observation, the number of initiations and responses were totaled for each participant.

Design

A reversal design (ABAB; Horner et al., 2005) was used to assess the effect of the Reading Buddies intervention on the initiations and responses of the participants with LFA and their typical peers. The ABAB or reversal design requires the active manipulation of the independent variable by the researcher who introduces the intervention after a period of stable baseline data. The researcher then reverses and goes back to the baseline phase and finally re-introduces the intervention phase. A functional relationship is demonstrated in the reversal design when the dependent variable co-varies (e.g. changes level or trend) in relation to the independent variable. For example, behavior decreases when a behavior-reduction intervention is introduced and
increases when the intervention is withdrawn. Researchers use visual analysis of the data graph to examine levels of the dependent variable across phases and/or to examine trends in the dependent variable across phases (e.g. is data trending down with a behavior reduction intervention and trending up during baseline phases).

The reversal design was chosen for this study because it was suitable for the classwide implementation of the intervention while also assessing individual participants. There were a total of 20 sessions across 10 weeks (average two sessions per week), alternating two weeks of baseline, three weeks of intervention, two weeks of baseline, and three weeks of intervention. Constraints of the public school schedule and the need to minimize disruption resulted in less than five data points in some phases.

**Intervention Procedures**

**Pre-intervention procedures.** Prior to the intervention, the researcher, who is a certified special education teacher, conducted a 20-minute overview about students with autism to the second-grade class. The purpose was to provide general information about students with autism and give the students an opportunity to ask questions since their prior indirect exposure to students with autism was limited to the playground, the outside lunch area, and school assemblies. She conducted a read aloud of *Since We’re Friends: An Autism Picture Book* (Shally & Harrington, 2007), and facilitated a discussion about how students could have a friend with autism and how friends can be alike and different.

**Baseline one procedures.** (Four sessions). To introduce the two classes to each other at the first baseline session, the teachers and researcher again facilitated a short discussion about how everyone was both alike and different. Then the students were told who was in their reading buddy group, and instructed to find their buddies, choose a book and go to their assigned place (e.g., small table, floor, desk area) to read. Students were not given any directions about how to interact with each other. Classroom teachers and staff intervened only if students needed to be redirected for inappropriate behavior. Groups read with each other for 15 minutes.

**Intervention one procedures.** (Six sessions). During the first intervention session, the researcher and teachers taught all of the students the three steps of the *Reading Buddies* intervention using a picture chart, modeling, role-play, and discussion. Individual students were called upon to explain the steps of the intervention to other students, and to role-play what it meant to be a good reading buddy. Students were shown how to use the happy face card to let their peers know they were doing a good job, and were reminded that they could earn a sticker for their own appropriate participation. Students then chose any desired book and read with the other members of their buddy group for 15 minutes, following a semi-structured format of 5 minutes for each book. Each subsequent session of the intervention phase began with a review of the three steps by the teachers and researcher using modeling, role-play and discussion. Students were also reminded to use the reinforcement system (e.g. “Remember to tell your buddy when they are doing a good job”).

**Baseline two and intervention two procedures.** For baseline phase two, the procedures during baseline phase one were replicated. The visual support was removed and there was no use of modeling, discussion, or role-play at the start of the session. Likewise the reinforcement system was withdrawn. The happy face cards were not used with participants with LFA and stickers were not provided for second-grade students. When students entered the classroom, they were simply instructed to find their buddy and read.

Moreover, the procedures during intervention phase two were replicated exactly as during intervention phase one. The visual support was present again and the teachers and researcher used modeling, discussion, and role-play to engage students at the beginning of each session. Reinforcement was also reinstated with second-grade students reinforcing students with LFA using the happy face cards, and the students with LFA reinforcing the second-grade students with stickers.

**Measures**

**Observational recording.** The initiations and responses of the participants with LFA and their typical peers were recorded on an observational data form. The form was a basic grid
with participant names across the top of the grid and underneath each name were two boxes, one for initiations and the other for responses. The left side column was labeled with the instruction to record data for two minutes. A gray horizontal bar ran underneath this entire set and was labeled with the words “30 second break.” This sequence was repeated four more times such that there were five sections altogether on the page, representing a total of 10 minutes of data collection and a total of two minutes of no recording. A total of 12 minutes were used to record the data. Data recorders allowed time for students to choose a book and settle into their area, approximately one to two minutes, before beginning data collection.

The observers used a tally mark placed in the appropriate box to indicate that an initiation or response had occurred and by whom. The data recorder totaled the initiations and responses separately for each participant at the bottom of the data sheet.

A total of six data collectors were trained and used in the study. Each of the four buddy groups had one assigned data collector and 10 minutes of data were collected on all four groups every session. Two additional data recorders rotated across the groups to observe and record data simultaneously with the assigned recorder, such that each group had 25% of sessions double-scored for reliability. The 30-second break after each two-minute session of data collection was put in place to provide data collectors with a brief respite from intense observation and recording of data.

**Interobserver agreement and treatment integrity.** All six data collectors were trained prior to beginning the study; one assigned to each group and two rotating for reliability data. Data collectors included the researcher (reliability) and five paraprofessionals (four assigned to groups and one rotating for reliability) employed with the district as behavioral support staff that regularly collected observational data as part of their job duties. Training was conducted with the data sheet using role-play among the adults and in-vivo practice with students with LFA in similar activities until 90% agreement was reached on all data collectors.

Interobserver reliability was achieved using two observers to record the initiations and responses of each buddy group. Interobserver agreement (IOA) was conducted on 25% of each group’s sessions. The percentage of interobserver agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements and then multiplying by 100. IOA for participants were Caleb 90%, Jack 80%, Mary 81%, and Thomas 91%.

Treatment integrity was assessed by using a simple checklist to make sure materials were in place (visual chart, books, markers, reinforcement cards) and that the steps of the intervention (stay with your buddy, read with your buddy, talk with your buddy) were reviewed and discussed each session of intervention. There were ten items on the checklist and treatment integrity was calculated each session as a percentage of items completed. As each item on the checklist was essential to the intervention, overall treatment integrity for the study was 100%.

**Social validity measures.** Social validity was assessed using open-ended interviews with eight randomly selected typical second-grade students with parental consent. The interview was comprised of questions related to the intervention and the relationship with the students with LFA. Examples of questions included:

(a) Do you think your buddy likes having you read to him/her in Reading Buddies? How can you tell?
(b) Do you and your buddy ever help each other out? (c) Do you think you and your buddy are friends? How do you know?

**Data Analysis**

Single-subject data analysis was used to compare the students’ initiations and responses across baseline and intervention phases, including visual inspection of the data for non-overlapping data points and a comparison of means across conditions (Horner et al., 2005). Interview data were analyzed using thematic analysis across questions. Interviews were coded as themes emerged by grouping similar comments together then further reviewed for categories within themes.

**Results**

Figures 2 through 5 show initiations and responses of all participants with LFA and typical peer groups throughout the study. Mean initiations and responses of all participants with LFA and typical peer groups are presented in Table 2.
Initiations

Participants with LFA. A visual analysis of the data focusing on the initiations of the participants with LFA reveals variability within and across conditions for all participants. Data did not represent a consistent change in level from baseline to intervention phases. As a result, these data do not support a functional

Figure 2. Participants with LFA Initiations.
relationship between the introduction of the intervention and increased initiations for participants with LFA.

Typical peers. Visual analysis of the initiations of the typical peers revealed that the participants did follow the expected pattern for baseline and intervention phases with improved initiations in both intervention phases. Comparison of the means support the visual analysis and indicate improved initiations by

Figure 3. Typical Peer Buddy Group Initiations.
all typical peer groups in intervention phases. Caleb’s peers increased mean initiations from baseline one ($M = 16.75$) to intervention one ($M = 32.00$), and from baseline two ($M = 16.50$) to intervention two ($M = 35.67$). Jack’s peers increased mean initiations from baseline one ($M = 19.25$) to intervention one ($M = 39.40$), and from baseline two ($M = 18.33$) to intervention two ($M = 64.50$). Mary’s peers increased mean initiations from baseline one ($M = 15.25$) to intervention one ($M = 36.60$), and from baseline two ($M =
to intervention two \((M = 41.17)\). Thomas’ peers increased mean initiations from baseline one \((M = 44.33)\) to intervention one \((M = 68.00)\), and from baseline two \((M = 35.50)\) to intervention two \((M = 42.80)\).

Responses

Participants with LFA. Visual analysis of the responses of the students with LFA indicated that the participants’ responses to peers in—
TABLE 2
Summary of Means

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<thead>
<tr>
<th></th>
<th>Initiation</th>
<th>Response</th>
<th>Initiation</th>
<th>Response</th>
<th>Initiation</th>
<th>Response</th>
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<tr>
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<tr>
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<tr>
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<tr>
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<td>SD=7.80</td>
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<tr>
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<td>M=8.75</td>
<td>M=42.80</td>
<td>M=16.50</td>
</tr>
<tr>
<td></td>
<td>SD=4.16</td>
<td>SD=10.60</td>
<td>SD=17.29</td>
<td>SD=3.99</td>
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<td>SD=9.08</td>
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</tr>
</tbody>
</table>

Increased for Caleb, Jack, and Mary during intervention phases. Caleb increased mean responses to peer initiations from baseline one (M = 4.50) to intervention one (M = 17.67) and again from baseline two (M = 5.25) to intervention two (M = 15.67). Jack increased mean responses to peer initiations from baseline one (M = 1.50) to intervention one (M = 15.60) and again from baseline two (M = 8.00) to intervention two (M = 24.00). Mary increased mean responses to peer initiations from baseline one (M = 6.50) to intervention one (M = 31.20) and again from baseline two (M = 23.75) to intervention two (M = 37.00). These data support the establishment of a functional relationship between introduction of the intervention and responses of these three students. However the functional relationship is not as strong as preferred because baseline two levels did not return to baseline one levels. Higher baseline two levels may indicate that the intervention was difficult to completely reverse once introduced. The visual analysis of data for the fourth participant with LFA, Thomas, revealed variability across conditions and did not indicate a functional relationship between the introduction of the intervention and Thomas’ response to peers.

Typical peers. Visual analysis of data graphs for typical peer responses to initiations made by participants with LFA indicates typical peers were only somewhat effective at responding to participants with LFA. Mary’s peers indicated improved responses to her initiations during the first intervention phase, but baseline two resulted in variability of responses before a general accelerating trend in the second intervention phase. Examining the means to support visual analysis indicates that Mary’s peers increased mean responses from baseline one (M = 0.75) to intervention one (M = 10.20) and from baseline two (M = 9.00) to intervention two (M = 17.33). However, a functional relationship is difficult to establish because baseline two data presented with variability that overlapped both intervention one and intervention two phases. Visual analysis of the remaining three peer groups indicates variability within and across conditions without demonstration of a functional relationship.

Social Validity

This study also examined the quality of the relationship between the students with LFA.
and the typical second-grade peers through open-ended interviews with eight of the second-grade students. Interview transcriptions were examined for common elements across participants, which were further grouped together by themes. Three main themes emerged: mutual enjoyment, helping behaviors, and developing friendships.

**Mutual enjoyment.** Typical peers expressed that the group enjoyed reading together and exchanging positive reinforcement. One student expressed, “He always hugs me on the arm and we always give him high fives. We are happy to interact with him.” Other participants stated, “We have lots of fun together,” plus “I like reading to him so he can be happy and he likes being with me,” and “It’s just been fun and I’d like to do it (again) next week.”

**Helping behaviors.** Typical peers described how they helped the student with LFA read and understand the book, and also how sometimes the student with LFA helped the typical students with reading. For example, the students stated, “We don’t hog the book to ourselves. We show them that they need to do what they are supposed to do,” and “He (student with LFA) listens to what I say when I point to something (in the book) or when I ask him a question or I ask him to do something with the book that involves the book.” They also expressed, “(Student with LFA) is actually a pretty good reader because he read the first word to me,” and “When I kind of get stuck on a word he (student with LFA) kind of says the beginning of the word.” In addition, participants indicated they helped each other with companionship saying, “We help each other if somebody feels bad, if he (student with LFA) feels bad or if I feel bad,” and “We don’t make him feel lonely.”

**Developing friendships.** Participants described being happy with their buddy and gave examples of how they knew they were friends. One student expressed, “I see him (student with LFA) sometimes at school and I can talk to him and I just like doing that because it just makes me happy.” Another participant indicated, “We are friends because whenever I hold his hand he holds it tighter,” and still another said, “Whenever someone else is reading to him, he (student with LFA) holds my hand, so I think we are good friends.” Another student said, “He’s my friend so if he was playing alone I would say don’t be lonely . . . do what you like doing with me.” When asked if he and his buddy with LFA were friends, a final student revealed, “Oh yeah definitely - Because we can do what we are best at doing together.”

**Discussion**

This study examined the effects of a classwide peer-mediated shared reading intervention, *Reading Buddies*, on the initiations and responses of students with LFA and their typical peers. The intervention proved more effective at increasing the initiations of the typical students than the initiations of the students with LFA. This is not entirely unexpected in light of the significant deficits in social communication skills displayed by the participants with LFA (Maljaars et al., 2011), and 10 weeks of intervention may not have been enough time to increase initiations toward peers.

A notable finding in the study was that increased initiations by the typical students lead to increased responses from three of the four participants with LFA. With the significant social deficits of the participants with LFA – all four showed little to no acknowledgement of peers prior to beginning the study – improving responses to peers’ initiations is extremely important. Responses require a level of attention to the typical peer when the initiation is made and for students characterized as having seemingly little awareness of the presence of others, increased responses to peer initiations is pivotal. Although the participants with LFA did not increase initiations, three of the four did increase responses to peer initiations, a critical component of reciprocal social interaction.

Improved responses to peer initiations is significant given that the participants with LFA were all served in a separate special education classroom with only limited opportunities for inclusion (e.g., lunch, recess, assemblies). None of the participants with LFA had previously been included with typical peers for academic activities. The *Reading Buddies* intervention provided an opportunity to participate in a shared reading activity and hear stories read by peers – an activity most typically-
developing students engage in on a regular basis in their classrooms.

The academic structure of the intervention may have contributed to the mean increases in initiations and responses between the students with LFA and their typical peers. The intervention did not specifically outline what types of initiations and responses to make, but rather the intervention encouraged participants to talk about the book. Results of the study indicate that the students were interacting during the shared reading activity and were not just initiating for highly preferred items as might occur in free-play settings. Results of the present study are supported by the literature from Kamps et al. (2002), which indicate that interactions may be higher in structured academic settings than non-academic settings, and by the work of Jackson and Campbell (2009) who found that typical peers displayed greater comfort in interacting with peers with autism in academic activities over recreational activities.

Both the peer-reading and peer-reinforcement components contributed to the students’ use of the Reading Buddies intervention. Students were able to refer to the visual chart that outlined the three steps of the reading component, and reinforce each other’s appropriate behaviors with the happy face cards and stickers. As interactions increased during intervention phases, the interactions themselves may have become more reinforcing for both groups of students, thus promoting reciprocity. This design is supported by several studies suggesting that effective peer-mediated interventions incorporate the use of visual cues and evidence-based instructional strategies, such as modeling and reinforcement to enhance student acquisition of skills (McConnell, 2002; Reichow & Volkmar, 2010; Zhang & Wheeler, 2011).

Further, the interview results indicate that typical second-grade students found the experience of being a peer buddy to be enjoyable and wanted their buddy to be happy. The second-grade participants’ discussion of physical affection, i.e. hugs, high fives, holding hands, was somewhat unexpected as students with autism are often characterized as not enjoying physical affection. The strength of the buddy relationship may have supported the display of affectionate interactions not otherwise exhibited by students with LFA.

Another area of interest is found in the second interview theme. While the second graders understood that they helped their buddies with autism through the reading and social interaction, the second-graders also expressed several ways in which the students with LFA helped them. The second-graders clearly indicated that their buddies with LFA were able to help with the reading at times, and were also able to help with a reciprocal emotional response. The second-graders appeared to value the input of their peers with LFA and felt they contributed to the relationship. Finally, every interview participant identified their buddy with LFA as a friend and provided examples of how they knew they were friends, lending support to the use of peer-mediated interventions as an important means of friendship development for students with LFA.

Limitations

Results of this study provide important information on the use of peer-mediated interventions to improve social interactions of students with LFA, though the study does have some limitations. This study is limited by small sample size and by variability in data across conditions. Students with LFA are known to display a range of characteristics and often struggle with consistency even after intensive intervention (Ben-Itzchak & Zachor, 2007). Also, baseline two levels rarely achieved baseline one levels, indicating it may have been difficult for students to “reverse” or “unlearn” the intervention once it was introduced. Finally, several participants had missing data due to illness and generalization probes were not conducted. Though typical students revealed in the interviews that they did interact with their peers with LFA in other areas of the school, constraints of the school schedule did not allow for the collection of generalization probes.

Implications for Future Research

Results of the present study indicate that the classwide peer-mediated shared reading intervention, Reading Buddies, was effective at increasing the social responses of three of the
four students with LFA. Further research is needed to determine to what degree individual characteristics (e.g., age, exposure to peers) influence the participants’ response to peer-mediated interventions. Thomas was the youngest participant and had less cumulative exposure to typical peers than the other participants with LFA. To what degree these characteristics influenced his response to the intervention is unknown. Schreibman and colleagues (e.g., Ingersoll, Schreibman, & Stahmer, 2001; Schreibman, Stahmer, Barlett, & Dufek, 2009) have begun to investigate responder and non-responder profiles and suggest that children with autism who display high peer avoidance might need additional support in inclusive settings.

The Reading Buddies intervention was composed of a peer-reading component and a peer-reinforcement component. Using the reversal design the peer-reinforcement component was withdrawn along with the intervention. Further research should include a component analysis of the intervention examining the shared reading activity with and without the use of reinforcers. Such an analysis may help determine whether the use of reinforcement is a critical component of the intervention.

Implications for Practice

The Reading Buddies intervention presented an effective classwide peer-mediated shared reading intervention to increase social interactions between typical second-grade peers and students with LFA. Multiple peers were trained in a short period of time and all members of the class were mediators of the intervention. Using multiple peers lessens the burden on any one participant to engage the student with LFA and allows for natural variation in social responsiveness from day to day (Harper et al., 2008; Laushey & Heflin, 2000). Training all members of a class also gives more students the opportunity to develop relationships with students with LFA, contributing to improved long-term outcomes for these students. Peer-mediated interventions that integrate visual cues, reinforcement for all participants, and specific structured strategies to promote interactions should be an integral component of classwide intervention programs (McConnell, 2002; Reichow & Volkmar, 2010; Stichter et al., 2007).

Conclusion

The success of the Reading Buddies intervention suggests that peer-mediated shared reading interventions can be used to increase the social interactions of students with LFA and typical peers. Further, interview findings indicate that typical students participating in peer-mediated interventions hold positive perceptions of peers with LFA and consider students with LFA to be friends. Given the significant social deficits of students with LFA and the lack of social skill interventions for this population, the importance of addressing positive friendships for students with LFA cannot be overstated.

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Sequence Learning with Stochastic Feedback in a Cross-Cultural Sample of Boys in the Autistic Spectrum

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Abstract: The study investigated sequence learning from stochastic feedback in boys with Autistic Spectrum Disorder (ASD) and typically developed (TD) boys. We asked boys with ASD from Nigeria and the UK as well as age- and gender-matched controls (also males only) to deduce a sequence of four left and right button presses, LLRR, RRLR, LRLR, LRRL, LRRL, and RLLR from a feedback signal. Results revealed no significant differences between the boys with ASD from Nigeria and the UK as both groups of boys improved during the task. Most interestingly, the ASD and TD group of boys learning differed for certainty, but not uncertainty of feedback. We concluded that further research is needed why boys with ASD did not benefit from true, logical and reliable feedback.

In recent years, researchers tried to find the underlying neurocognitive impairments to explain the symptoms of Autistic Spectrum Disorder (ASD) (Poljac & Bekkering, 2012). The symptoms of ASD as classified in the DSM-V comprise of persistent deficits in social communication and interaction across multiple contexts as well as restricted, repetitive patterns of behaviour, interests and activities (American Psychiatric Association, 2013). Because the severity and diversity of impairments varies across individuals, the term autistic spectrum disorder (ASD) was proposed (Poljac & Bekkering, 2012; Sheinkopf, 2005). There are low ability children, but also high-functioning (HF) children with ASD who can show extraordinary drawing, mathematical and/or memory abilities (Boucher & Bowler, 2008; Happé & Frith, 2010).

The current study investigates sequence learning in children with ASD who are of low to average ability. One of the first researchers examining sequence learning in children was Piaget (1952). He asked children to sort sticks of different lengths into a sequence according to size (seriation). Young children had no idea about seriation and would rather sort the sticks into aesthetic arrangements, while school-age children used strategies that were linked to their understanding of the concepts of dimension and scale. However, deductive sequence learning can also be drastically impaired in 8–11-year-old typically developing children when they encounter stochastic feedback (Lange-Küttner, Averbeck, Hirsch, Wiesners, & Lamba, 2012). We investigated this condition for sequence learning in autistic boys and age-matched control children in a within-subjects design. In the first half of the session, the sequence could be logically deduced from deterministic, correct feedback, while in the second half of the session, sequence learning needed mental estimation of the likelihood of feedback accuracy because it was randomly incorrect in 20% of the trials (stochastic feedback). We expected that boys with autism would be more dependent on deterministic feedback than neurotypical children. Furthermore, we compared boys with ASD from Nigeria and the United Kingdom in order to ascertain whether schooling experience and cultural socialization would ameliorate ASD-specific deficits.

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Executive Function and Sequence Learning

One core neurocognitive impairment that is related to deficits in ASD is executive dysfunction (Amaral, Collins, Bohache, & Kloos, 2012; Carr, 2006; Groen et al., 2008; Hill, 2004; Poljac & Bekkering, 2012; Rajendran & Mitchell, 2007). Executive function (EF) describes neuropsychological processes which enable physical, cognitive and emotional self-control and are necessary to maintain goal-directed behaviour (Corbett, Constantine, Hendren, Rocke, & Ozonoff, 2009). It is an umbrella term for various cognitive abilities such as sequencing, planning, impulse control, and inhibition that are involved in regulation and co-ordination of thoughts and actions (Amaral et al., 2012; Hill, 2004; Sheinkopf, 2005). EF is related to the Intelligence Quotient (IQ) (Liss et al., 2001).

Sequence learning can also occur when children have to deduce a sequence. For instance, if in a motor sequence task with left (L) and right (R) button presses, LRLR is the correct sequence, but the child pressed LLLR and would get the feedback correct, wrong, correct, correct, the child can deduct the correct sequence and adjust the second button press after the first round of feedback (Lange-Küttner et al., 2012). Lange-Küttner et al. compared sequence learning under certainty and uncertainty. This meant that one group of children always received correct feedback (deterministic feedback), while another group received just 85% correct feedback (stochastic feedback) and had to decide whether the feedback was trustworthy or not. Lange-Küttner et al. found that the group receiving stochastic feedback started on a significantly lower performance level compared to the control group receiving deterministic feedback, but became more confident and gradually increased performance. However, they did not reach the performance level of the group learning from deterministic feedback even when they repeated two rounds of six sequences.

The researchers also evaluated whether children learned more from positive or negative feedback and showed that the probability of learning was increased after positive feedback, whether it was correct or false. That is, they also learned from false positive feedback. Moreover, children found it especially hard to reject false negative feedback, that is, when the signal showed they were wrong when in fact they were right. This required a degree of self-assertion that this large sample of 8- to 11-year-old children could not yet master. This result showed that processing stochastic feedback also had a social aspect because it was agreeable for children when the computer feedback would praise them indiscriminately, but disturbed their learning when the critical feedback was unjustified.

Executive Function and Sequence Learning in Children with ASD

Learning of sequences is fundamental to human performance. It is used not only in mathematics, but also in a variety of everyday tasks, for example movements when getting dressed (Clegg, DiGirolamo, & Keele, 1998). This makes sequence learning also an important factor for low-ability children with ASD because they frequently fail in everyday tasks such as creating a shopping list (Charitos et al. 2000). The theory of executive function can explain the behaviour problems of rigidity and perseveration seen in ASD by testing, for instance, the lack in initiation of new non-routine action and the tendency to be stuck in a given set (Hill, 2004). One aspect of this executive dysfunction is weak central coherence which is characterized as shifting attention from local elements to global patterns (Amaral et al., 2012; Happé & Frith, 2006). A critical review regarding the theory of executive dysfunction in children with ASD carried out by Hill (2004) showed that overall children with ASD tended to be impaired in planning, mental flexibility, which includes set-shifting and cognitive flexibility, inhibition and self-monitoring. Also, more recent studies confirmed that children with ASD showed impairments in planning, inhibition and self-monitoring (Corbett et al., 2009; Happé, Booth, Charlton, & Hughes, 2006; Robinson, Goddard, Dritschel, Wisley, & Howlin, 2009). However, when Robinson et al. controlled for age differences, she found age-related gains in mental flexibility, planning and the speed of response, but not in response inhibition and self-monitoring. Happé et al., (2006) also
found that older children with ASD outperformed younger ones with ASD which indicates that executive function may increase with age despite the disability. However, in a longitudinal study by Ozonoff and McEvoy (1994) over three years, little improvement was seen in planning, working memory and cognitive flexibility.


Implicit sequence learning takes place without awareness insofar as there is no explicit instruction or intention to learn (Brown, Aczel, Jiménez, Kaufmann, & Grant, 2010). However, Ferdinand, Mecklinger and Kray (2008) showed that sequence learning occurs irrespective of the learning condition because children learned equally when they were explicitly informed about the existence of a sequence they had to learn and when they were not informed.

So far, sequence learning in ASD has mainly been studied using the Serial Reaction Time (SRT) task. In this task, participants are asked to respond as quickly and accurately as possible to a black dot appearing in one of four locations on a screen by pressing four corresponding buttons. The locations of the dots are repeated in a particular sequence (Brown et al., 2010; Gordon & Stark, 2007). A variation of the SRT task is the Alternating Serial Reaction Time (ASRT) that uses a random dot appearance which hides the sequence better (Barnes et al., 2008). These studies tested whether implicit learning in children with ASD is impaired. The evidence on sequence learning is mixed: Some studies showed a difference in sequence learning between children with ASD and typically developed children (Gordon & Stark, 2007; Mostofsky, Goldberg, Landa, & Denckla, 2000), while others did not (Barnes et al., 2008; Brown et al., 2010; Nemeth et al., 2010).

These differences may be explained by different study designs. Brown et al. (2010) found no significant difference between children with ASD and typically developing children when using the SRT task, even though children were matched by IQ. Also Barnes et al. (2008) compared high-functioning individuals with ASD and Asperger who had an IQ in the normal range with typically developed children and matched them by chronological age. They used the ASRT task with three elements in a sequence and found no differences between the groups. Nemeth et al. (2010) also used the ASRT, but with eight elements and compared high functioning children with ASD to typically developing children matched for chronological age and IQ. They also did not find a difference between the two groups.

Mostofsky et al. (2000), however, did find a difference between individuals with ASD and typically developing individuals matched by age when using the SRT with still longer sequences, that is, ten elements.

Inui and Suzuki (1998) found that adolescents with ASD improved with practice in the SRT task. Gordon and Stark (2007) showed that low functioning 6- to 14-year-old children with ASD learned slower, made more errors and showed a greater variability. However, they still found significant learning progress in the first session with the four element sequence, suggesting that low functioning individuals with ASD are capable of learning a sequence with a lower cognitive load, respectively set size of the elements in the sequence.

The differences observed in these studies can be explained in different ways. One explanation could be the selection of participants. Individuals with ASD varied by age and severity of symptoms between studies, for instance, some studies just included high functioning children with ASD and Asperger. Furthermore, control groups of typically developed children might have been more likely to use explicit strategies. Moreover, the different procedures, such as the number and presentation timing of elements can contribute to differences. Hence, it appears that there is no consensus whether autistic children are just as good as age-matched controls when it comes to sequence learning. This is in line with Ama-
ral et al., (2012) who stress that differences in age, severity of symptoms, co-morbidity with other disorders such as ADHD, or task integration of movements can have more or less of an impact on performance. Thus, so far no definite conclusion can be drawn from this review about the ability of sequence learning in children with ASD.

Feedback Processing in Individuals with ASD

The current study uses a task with a sequence of just four button presses, but with different types of feedback. Feedback processing implies information uptake for error correction which is yet another aspect of executive functioning (Bogte, Flamma, van der Meere, & van Engelend, 2007). The processing of feedback develops during childhood until early adulthood and is important for many learning situations. Ferdinand et al., (2008) report that children react stronger to external feedback than adolescents and adults and are less efficient in extracting the relevant information from the feedback. This means that with age the ability to shift from external to internal feedback monitoring and the relationship between error monitoring and behavioural adaptation seems to strengthen. Furthermore, Eppinger, Mock and Kray (2009) showed that children and adults have a similar accuracy when presented with valid feedback, but they could observe differences when a proportion of the feedback was invalid. However, it is important to distinguish between social and performance feedback (Lange-Küttner et al., 2012) to better understand the impairment of children with ASD.

Individuals with ASD are less motivated by social feedback (Ingersoll, Schreibmann, & Tran, 2003). For instance, they do not experience feedback information from emotional facial expression in the same way as typically developed individuals do (Stel, van den Heuvel, & Smeets, 2008). Although individuals with ASD have difficulties in processing the more subtle social feedback, in a study using a computer task with visual feedback they have been found to process external feedback similar to typically developed individuals (Larson, South, Krauskopf, Clawson, & Crowley, 2011).

With regards to performance feedback, Russell and Jarrold (1998) show that 6- to 16-year old children with ASD generally make more errors and a higher proportion remained uncorrected, that is they show poorer skills in error correction. Also Bogte et al. (2007) found that typically developed individuals slow down after making an error to adjust the behaviour, while high functioning individuals with ASD did not, thus more errors occurred.

Other studies support the notion that children with ASD process negative but also positive performance feedback differently from typically developed children. In the study of Groen et al. (2008), 10- to 12-year old children with ASD showed no feedback monitoring deficits in a probabilistic learning task which involved selective responses to pictures based on informative feedback or response-independent button presses. Children with ASD showed some affective flattening in the evaluation of negative feedback compared with TD control children. A similar observation was made by Broadbent and Stokes (2013) in a life-span study with individuals with ASD from age 14 to 70 and controls on the Wisconsin Card Sorting Test (WCST). In the WCST the participant is asked to sort the cards to certain criteria. The researcher gives feedback on the performance, but changes the sorting rule after some time without the knowledge of the participant. The test measures the perseverative responses and errors of the participant. Broadbent and Stokes (2013) found that children with ASD showed more perseveration as they stayed for longer with the first, initial card sorting strategy. Additionally, children with ASD performed significantly better without negative feedback (Broadbent and Stokes, 2013).

In the current study, we devised stochastic feedback (Lange-Küttner et al., 2012). This is different to the implicit feedback change in the WCST, because children are explicitly told that a percentage of the feedback is not correct. On the one hand, we expected the same selective uptake of positive feedback for sequence learning as the control children, but on the other hand, we presumed that children with ASD may be comparatively indifferent to the random false feedback as one hallmark of autism seems to be that adult individuals appear to follow their own agenda when learning (Bowler, Gaigg, & Gardiner, 2008).
The Influence of Culture on ASD

One aspect where still little is known is the difference between ASD in different countries, particularly African countries, and the influence of culture on the symptoms and cognitive processes on children with ASD (Ametepee & Chitiyo, 2009; Weru, 2005). Therefore, the aspect of culture is included in this study by not only looking at children with ASD from England, United Kingdom, but also from Nigeria, Africa.

Children in Africa started only in recent years to receive a diagnosis of ASD because for a long time ASD was thought to be a problem of Western industrialized countries with high technological development (Bakare & Munir, 2011a, Bakare & Munir, 2011b, Sanua, 1984, Lotter, 1978). The symptoms of ASD in African countries are similar to those in Western countries (Lotter, 1978, Dhadhphale & Lukwago, 1982, Khan & Hombarume, 1996). Nevertheless, Lotter (1978) reported that ASD children in Africa showed less repetitive movements and less ritualistic activities involving objects compared to Western children in the autistic spectrum. A more recent cross-cultural study by Weru (2005) examined behavioural differences in autistic spectrum symptoms in African American children in the United States and children in Kenya. This study revealed that children with ASD in Kenya have more behavioural problems compared to African American children with ASD, with more severe problems of stereotyped behaviour, social interaction, social and self-help skills. Furthermore, they are more developmentally disturbed and have more communication problems. In particular, Weru (2005) found 13 Kenyans in the autistic spectrum to be entirely non-verbal compared to just one African American. The higher incidence of non-verbal cases in Africa is supported by other researchers (Bakare & Munir, 2011a, Lotter, 1980, Mankoski et al., 2006). Moreover, in African children, ASD has a comparatively higher impact on their intellectual ability (Bakare & Munir, 2011a, Lotter, 1980, Mankoski et al., 2006).

It remains unclear if the results of the studies really represent an objective picture of ASD in Africa, since most studies were conducted in poor urban environments. Access to professional health facilities is not guaranteed and specialist treatments often have to be paid for privately. The higher number of severe cases of ASD in Africa may be due to a sampling bias towards poor urban children. Furthermore only the very severe cases get reported in the first place (Bakare & Munir, 2011a). One reason for only reporting severe cases is that ASD often remains unrecognised by Nigerian healthcare workers (Bakare & Munir, 2011a) who often show a low level of knowledge and awareness about ASD (Bakare et al., 2009). This review highlights the fact that the research in the field of ASD in Africa is not yet very extensive. Especially in the field of cognition, it is not known whether African culture has an influence on ASD.

This current study aims to fill this gap in research by comparing Nigerian children in the autistic spectrum with British children in the autistic spectrum. The study only includes boys, as ASD is more common among boys than girls. In Western countries boys are four times more likely than girls to be in the autistic spectrum (Weru, 2005), and in Africa there is a similar male:female ratio of 3.8:1 (Ametepee & Chitiyo, 2009). Furthermore, pre-tests will be performed to assess the cognitive ability of the children from the UK and Nigeria with ASD in order to avoid differences in the cognitive ability as a confounding factor for differences in the sequence learning task. Hence, this study will examine sequence learning from feedback under certainty (deterministic feedback) and uncertainty (stochastic feedback) in children with ASD to assess the influence of culture. It is expected that culture will have an influence on sequence learning insofar as UK children with ASD will perform better than children with ASD from Nigeria as previous studies showed that the children with ASD in Africa are more impaired than children in Western countries. Our review further suggests that children with ASD will be able to learn the given sequences, as they just contain four elements, however, the stochastic feedback should make the learning of these short series of button presses somewhat harder. Additionally, a difference in the processing of the positive and negative feedback between the children with ASD and the typically developed children is expected.
insofar as normally developing children may be more responsive to feedback.

**Method**

**Participants**

Twenty-two boys with ASD between 7 and 12 years of age received parental consent to participate in the study. The group from Nigeria consists of 13 boys with ASD, and the group from the UK consists of nine English boys with ASD. Six boys of this sample were excluded. Four boys were excluded from the study as they were not capable to perform the pre-tests (see Apparatus and Material) and two boys because of missing data in the button press task. Five of the six boys were in the Nigerian group and one was in the English group, which resulted in \( N = 16 \) participants, eight with ASD from Nigeria and eight with ASD from the UK. All 16 participants with ASD completed the sequence learning task under the deterministic feedback condition. Fourteen of these also finished the sequence learning under the condition of stochastic feedback, seven from the Nigerian group and seven from the UK group.

Typically developing (TD) children from western European countries were selected as control group matched for chronological age and gender from a study with a large sample (Lange-Küttner et al., 2012). In this study, the deterministic and stochastic feedback conditions were tested with a between-subjects design. Hence, for each participant in the current study, two control children were selected, one for the deterministic feedback and a second one for the stochastic feedback condition. Also the control children were boys only. The date of birth was matched for the exact month of birth in most cases, see Table 1. The Nigerian boys with ASD were significantly older than the English boys with ASD, \( t(14) = -2.68, p = .018, d = .63 \), because the diagnosis was made later. Hence, age was controlled in the analyses with age in months as a covariate.

**Apparatus and Materials**

Before starting with the sequence learning task, all boys with ASD completed three pre-tests to assess the cognitive ability: (1) Draw-A-Person (DAP) test from Naglieri (1988); (2) Colored Progressive Matrices (CPM) (Raven, Court, & Raven, 1990); and (3) The British Picture Vocabulary Scale (BPVS-III, third edition) (Dunn et al., 2009).

**Draw-A-Person Test (DAP).** The DAP test by Naglieri is a screening test for the cognitive developmental status. Children are asked to draw a man, a woman and the self. The scoring captures the amount of details in the figures and psychometric norms are available (Naglieri, 1988). It is one of the most widely internationally used screening tests and is assumed to be culturally fair because it does not draw on specific knowledge (Lange-Küttner, Küttner, & Chromekova, 2014; Naglieri, 1988).

**Raven Coloured Progressive Matrices Test (Raven).** Also this test minimizes the cultural influences and aims to measure spatial reasoning by asking the child to choose the correct piece from six picture fragments to complete a pattern (Raven et al., 1990; Raven, 2000). It is a non-verbal test with no time restrictions.

**British Picture Vocabulary Scale.** The BPVS III assesses receptive vocabulary of a child and allows to draw a conclusion about the cognitive development in the area of verbal intelligence (Dunn et al., 2009). In the test, the child is asked to select one from four pictures shown on a page that best fits the word that the researcher said.

**Sequence learning task.** The sequence learning task is a computer task developed with Matlab (MATHWORKS). The child learns a sequence of four left (L) and right (R) button presses in the absence of any visual or auditory stimulus. The four correct left and right but-
ton presses had to be deduced from visual feedback (red/green) on the screen. The sequences were LLRR, RLLL, LRLR, RLRL, LRRL and RLLR. After each button press a circle appeared in red (wrong) or green (right) as feedback indicating if the child’s action was right or wrong. Each feedback trial had a number 1, 2, 3 or 4 inside the circle which indicated the position of their button press in the sequence, see Figure 1.

If the child pressed the left button for the first position of the sequence and a green circle appeared the child knew that the first button press in this sequence had to be the left one. However, if the child pressed first the right button and the red circle appeared, the child could deduce from the feedback that the first button press of the sequence was not the one on the right side and it consequently had to press the left button in the next round.

In this study, participants performed the task three times (rounds). Each round contained the six different sequences. Before each round, the child was informed about the type of feedback. In the first round, children always received the correct, veridical feedback (deterministic feedback, 100% correct). In the second and third round the child received only 80% correct feedback with 20% randomly incorrect feedback (stochastic feedback). This means that even if the child pressed the right button, the feedback could have indicated that this was wrong. Conversely, if the child pressed the wrong button the feedback might have indicated that the response was correct. Stochastic feedback was more difficult to integrate than deterministic feedback since the child was required to integrate it over multiple response sets to determine the correct sequence.

After the child identified the correct sequence he was asked to repeat these button presses to show that the sequence was learned properly and that the first correct sequence was not a chance event. In the first round with the deterministic feedback the child had to repeat the sequence six times before moving on to a new sequence. In the second and third round with stochastic feedback, the child had to repeat the sequence four times before moving on. If the child failed to detect the correct sequence within 20 sets of button presses, the program automatically moved on to the next sequence. Before starting a new sequence the instruction: “You have a new sequence to learn” appeared on the screen to inform the child. There was no time constraint, the button-pressing task was self-paced and only the accuracy was measured which made it suitable for children with developmental and mental health difficulties.

Averbeck et al. (2011) developed a formal learning model, with two learning parameters, a positive and a negative learning parameter. The positive learning parameter measures how likely the child was to press the correct button in the next response set after receiving positive feedback. The negative learning parameter measures if negative feedback decreased the likelihood of learning to press the correct button in the next response set.

As mentioned before, the TD children were selected from the large sample of Lange-Küttner et al. (2012). Their task was minimally different from the current one. They used a between-subject design where children in the deterministic feedback group had to enter the sequence eight times, compared to the children with ASD in this study who just entered it six times. The stochastic feedback group had to enter the correct sequence six times, while
the children with ASD in this study entered it just four times. Hence, we had lowered task demands for the children with ASD. The number of correct sequence repetitions was adjusted down for this study because we tested a clinical sample of medium to low ability. Moreover, the stochastic condition for the ASD children was 80% rather than as previously 85% stochastic feedback (Lange-Küttner et al., 2012), but this was only a very small difference.

Procedure

Approval was obtained from the London Metropolitan University ethical board as well as from the ethical committee from the Ministry of Health in Nigeria. In Nigeria, potential participants were identified with the service provider Playsmart. Playsmart sent out an information letter to schools with integrated children with ASD and centers working with children with ASD, whether they were aware of boys within the age range with ASD. If schools or centers agreed to support the study, a meeting between the first author and the person in charge of the school or center was arranged to explain the procedure. Afterwards, an information letter and a consent form were sent to the parents. Parents were also contacted directly at institutional meetings, where information was provided together with the information letter and consent form. If parents agreed for their sons to participate in the study, children were tested either in the school, or the center, or at the child’s home. In all cases it was made sure that a known person to the child was present throughout data collection; this was either a therapist, psychologist, teacher, assistant, or the parent.

In the UK, special schools for children with ASD and organizations working with children with ASD were directly contacted with an information letter. When schools or organizations agreed to support the study, more information about the procedure was provided and an information letter and consent form was sent out to the parents who were known to have a child with ASD within the age range. Like in Nigeria, sessions took either place in the school or at the child’s home, and in both cases it was made sure that either the teaching assistant or the parent was present.

The testing was distributed across two sessions. In the first session, the psychometric assessments were carried out. The time needed for the first session varied between 30 and 75 minutes. In the second session children performed the sequence learning task on a laptop. The time needed for this session varied between 40 and 100 minutes, since children could take breaks in between sets.

In the beginning the child would either read the instructions from the screen individually or the researcher would read them out loud, depending on the reading ability and preference of the child. The instructions for the deterministic feedback were depicted in several screenshots:

Welcome to the “Learn the 4 Button Press”. You are given two buttons to press. You need to learn to press these buttons in a particular sequence, making a total of 4 button presses. For instance, Left, Right, Left, Right. Each time you press a button a GREEN or a RED circle will appear. The circle is like a streetlight which shows whether you pressed the right or wrong button. The computer always gives you the correct feedback. When you press the CORRECT button a green circle will appear. When you press the WRONG button a red circle will appear. After learning the correct 4 Button Presses repeat the same sequence six times and you will proceed to learn another new sequence.

After finishing the deterministic feedback condition, the instruction for the stochastic feedback condition were given in several screenshots:

Welcome to “Learn the 4 Button Presses task”. This task is the same task as before, except this time the computer will also give you wrong feedback 20 percent of the time. Even if you pressed the right button it may appear as false with a red circle. Even if you pressed the wrong button it may appear as right with a green circle. Therefore even if you think you know the sequence sometimes you may have to ignore the feedback. Are you ready?

The researcher showed the child the two buttons. The left index finger was put on the “z” button and the right index finger on the “-” button on a UK/US keyboard layout. Both
buttons were marked with a coloured sticker. The child was asked to keep the fingers on the keyboard during the task.

Results

The results are reported in two parts. In the first part, the boys with ASD from the two countries are compared, while in the second part they are compared as one group to the typically developing (TD) boys. When the Mauchley’s Test of Sphericity was significant, degrees of freedom were adjusted according to Huynh-Feldt.

Results for Children with ASD

**Pre-tests.** The results of the three pre-tests assessing the cognitive ability of the boys with ASD from the two countries are listed in Table 2. For analyses of group differences, the raw scores were used because some participants scored outside the normative scale and no standard scores could be obtained. One boy could not draw a figure, but completed all other tests and hence was included in the analyses. There were no significant differences in any of the tests, $p_i > .217$. Nevertheless, the English boys with ASD scored higher in all three tests compared to the Nigerian boys with ASD, but because the standard deviations were high in both groups (indicating a wide range of ability in both groups), the t-tests did not reach significance.

**Sequence learning.** The first six response sets were averaged across the sequences LLRR, RRLR, LRLR, RLRL, LRRL and RLLR, in the deterministic feedback condition for one round, and in the stochastic feedback condition for both rounds.

A 6 (response sets) by 2 (feedback conditions) by 2 (country of origin) analysis of variance was run with repeated measures on the first two factors and country of origin as between-subject factor. There were no significant effects of the country of origin and feedback condition, $p_i > .313$. This showed that boys with ASD from both countries showed the same performance level and learned under both feedback conditions to a similar extent. Nevertheless, the analysis revealed a significant main effect of response sets, $F(3.36,16) = 8.92, p < .001, \eta^2 = .43$. Within-subjects contrasts (Difference) showed a significant increase of correct responses with almost every learning set, $F_s > 5.47, p_i < .033$.

When this analysis of variance was controlled with age as a covariate, the significant effect of learning set disappeared, $p > .970$, showing that age explained the learning effect. There was still no significant difference between the boys with ASD from Nigeria and the UK, $p > .432$. This result clearly demonstrated that sequence learning in boys with ASD was related to age and not to the country in which they lived.

**Positive vs. negative feedback.** The feedback-related learning parameters were analysed in a 2 (positive/negative feedback) by 2 (feedback condition) by 2 (countries of origin) analysis of variance with repeated measures on the first two factors and country of origin as

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Note. Degrees of freedom were adjusted when Levene’s test for equality of variances was significant.

# TABLE 2

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Note. Degrees of freedom were adjusted when Levene’s test for equality of variances was significant.
between-subject factor. There were no significant statistical effects, except for positive vs. negative feedback which had a very large effect size, $F(1,16) = 93.08, p < .001, \eta^2 = .89$. All boys with ASD learned significantly more from positive than from negative feedback in both the deterministic and the stochastic feedback condition. When this model was controlled for age, the feedback effect was reduced by more than half, but remained significant, $F(1,16) = 6.58, p = .026, \eta^2 = .37$. No other factor was significant, $p > .400$.

**Children with ASD and the TD Control Children**

As it was found that there was no significant performance difference of the Nigerian and the English boys with ASD, their data were collapsed into one ASD group and compared with age- and gender-matched TD groups, one group for the deterministic feedback and one group for the stochastic feedback condition, because the TD boys were selected and matched from a sequence learning study with a between-subjects design (Lange-Küttner et al., 2012).

**Sequence Learning**

**Deterministic feedback.** A 6 (response sets) by 2 (ASD/TD group) analysis of variance was run with repeated measures on the first factor and group as between-subject factor. There was a significant main effect of groups, $F(1,30) = 16.89, p = .001, \eta^2 = .36$, indicating that the boys in the TD group learned on a significantly higher level compared to the boys with ASD, see Figure 2, left side. There was also a significant effect of sets, $F(4.41,30) = 6.94, p = .001, \eta^2 = .19$ and a significant interaction between groups and sets, $F(5,30) = 2.42, p = .04, \eta^2 = .08$. Even though the boys in the TD group performed significantly better, also the boys with ASD showed learning and narrowed the gap, see Figure 2, left side.

**Stochastic feedback.** The same analysis of variance for sequence learning with stochastic feedback. There was no significant difference between the TD group and the ASD group, $F(1,28) = 0.19, p = .670, \eta^2 = .01$. This means the boys in both groups showed a similar performance level. There was a significant main effect of response sets, $F(4.43,28) = 12.39,$
Within-subjects contrasts (Difference) showed a significant increase of correct responses with each learning set in both groups of boys, $F_{15.38} = 15.38$, $p = .03$. Independent sample $t$-tests showed that the TD boys learned significantly more from positive feedback than the boys with ASD, $t_{15.64} = 5.11$, $p < .001$, and also from negative feedback $t_{15.64} = 2.45$, $p = .026$. The interaction of feedback and group was not significant, $p = .830$.

**Stochastic feedback.** The same analysis of variance was run for feedback learning in the stochastic feedback condition, group means are plotted in Figure 3, right. There was an even larger significant effect of positive vs. negative feedback type in the stochastic condition, $F_{15.26} = 126.72$, $p < .001$, $\eta^2 = .83$, as all boys in both groups learned more from positive than negative feedback. No other effects were significant, $p > .237$.

$p = .001$, $\eta^2 = .32$, see Figure 3, right. Within-subjects contrasts (Difference) showed a significant increase of correct responses with each learning set in both groups of boys, $F_{15.38} > 15.38$, $p < .03$.

**Positive vs. Negative Feedback**

**Deterministic feedback.** A 2 (positive/negative feedback) by 2 (ASD/TD group) analysis of variance was run with repeated measures on the first factor and group as between subject factor, group means are plotted in Figure 3, left. A significant effect of the feedback type $F_{15.30} = 43.15$, $p < .001$, $\eta^2 = .59$, showed that all boys learned more from positive than from negative feedback. There was a significant difference, however, between the ASD and the TD boys, $F_{15.40} = 15.40$, $p < .001$, $\eta^2 = .34$. Independent sample $t$-tests showed that the TD boys learned significantly more from positive feedback than the boys with ASD, $t_{15.64} = -5.11$, $p < .001$, and also from negative feedback $t_{15.64} = -2.45$, $p = .026$. The interaction of feedback and group was not significant, $p = .830$.

Figure 3. Learning from positive and negative feedback in ASD and TD boys in the deterministic (left) and stochastic (right) feedback condition. Bars indicate the standard error. **$p < .001$; *$p < .05$.**
Discussion

Cultural Differences in Sequence Learning

In this study, we investigated whether sequence learning from feedback under certainty and uncertainty is impaired in boys with ASD and whether culture would have an influence. A comparison was made with a control group of typically developed boys matched for gender and month of birth. The study revealed no significant difference in the sequence learning task between the groups of boys with ASD from Nigeria and from the UK. Both ASD groups learned equally well after each set of button presses and processed the feedback in a similar fashion. This result indicates that sequence learning and the processing of feedback in boys with ASD is independent of schooling experience and culture. Therefore we would conclude that sequence learning in ASD is not influenced by cultural life circumstances. This result supports the findings that ASD is not just a problem of Western industrialized countries (Bakare & Munir, 2011a; Bakare & Munir, 2011b; Lotter, 1978; Sanua, 1984). However, cultural independence of sequence learning in boys with ASD is in contrast to the findings of Weru (2005) who found children with ASD from Kenya to be more impaired in general than children with ASD from the United States of America. However, in our study sequence learning in boys with ASD was related to age which suggests that also in the autistic mind there is a healthy core of executive functioning skills even if these do not reach the same level as in typically developed children (see also Happé et al., 2006; Ozonoff & McEvoy, 1994; Robinson et al., 2009).

Positive and Negative Feedback Processing and Sequence Learning

Feedback processing develops throughout the life-span (Störmer, Eppinger, & Li, 2014). Positive feedback is important in young children (Lange-Küttner et al., 2012), but still increases response consistency in adults (Störmer et al., 2014). However, also negative feedback processing gradually emerges in children (Crone, Bunge, Latenstein, & van der Molen, 2005; Lange-Küttner et al. 2012). The current study shows that typically developing boys not only learned more from feedback in the deterministic feedback condition, but they were even able to learn from negative feedback, while boys with ASD were not. This clearly shows that when learning a sequence, positive feedback is especially important for boys with ASD. The result is in line with findings of Broadbent and Stokes (2013) who found that children with ASD learned better when negative feedback was removed from a task. In the psychophysiological study of Groen et al. (2008) attention to negative feedback gradually decreased during their task in both ASD and TD children, but not in non-medicated children with ADHD. Likewise, children with ASD did not show deficits in error monitoring, but non-medicated children with ADHD did. In contrast, both non-medicated ADHD children and children with ASD showed strong anticipation of positive feedback, while there were no differences between the clinical groups and the TD children with respect to anticipation of negative feedback.

In short, the current study showed that typically developed boys recognize reliable feedback, whether it is positive or negative, while boys with ASD did not, as they seem to show an increased distrust of any feedback except if it is explicitly positive. Nevertheless, they were able to learn a sequence from stochastic feedback as well as normally developing boys. Our initial intuition was that English ASD boys should benefit from the advanced educational system and the reliable, deterministic feedback, but it seems that all that was needed was explicit positive reinforcement. This is not expensive to provide and thus can be delivered in any country. This means, schools and facilities as well as parents and other carers for children with ASD should focus more on praise and positive feedback when teaching and reduce the negative ones. Furthermore, tasks need to be adjusted insofar as the focus would be on achievable goals.

Deterministic and Stochastic Feedback

Surprisingly, in the stochastic feedback condition, differences in the processing of positive and negative feedback between the TD boys and boys with ASD were diminished and learning was the same (see Figure 3, right). We had
expected that because TD boys find stochastic feedback processing difficult, boys with ASD should find it even more difficult, but this was not the case. It became very clear that there was no significant difference between sequence learning under certainty and uncertainty in the two groups of boys with ASD, while the control boys performed significantly better under deterministic feedback than the ones receiving stochastic feedback.

One reason could be that the group of boys with ASD in this study did both feedback conditions, starting off with the deterministic version. This means the boys with ASD had the advantage of knowing parts of the task already when starting to receive stochastic feedback and therefore did as well in this condition, because practice can have an impact in children with ASD (Inui & Suzuki, 1998), for instance in categorization (Groen et al., 2008). A practice effect in this logical deduction task would still be a remarkable learning effect in the boys with ASD.

Another explanation could be that an impairment in executive functions and therefore the lack of initiating new responses and actions (Hill, 2004), the need for sameness and strong tendency towards repetitive behaviour (Poljac & Bekkering, 2012), along with a lack of error correction (Russell & Jarrold, 1998) may have had an unexpected positive effect insofar as misleading feedback did not matter as much for ASD boys as for the control boys. It may be that children with ASD also follow their own agenda when learning - like adults with ASD (Bowler et al., 2008).

However, one could also turn this argument around and conclude that boys with ASD did not benefit as much as TD boys from true, deterministic feedback. This explanation is more straightforward as the boys always received the deterministic feedback first but still may have already distrusted this kind of feedback as much as the stochastic feedback even if it was veridical. This would mean that while typical developed children are more likely to trust and rely on information (Harris, 2012), children with ASD may base their decisions on their own autonomous ideas which may be one of basic mistrust, instead of socially guided information. Also parents of children with ASD show a high rate of social phobia suggesting that these parents would be more suspicious of feedback than parents of typical developing children (Piven & Palmer, 1999). Further children with ASD have many common as well as unusual fears and phobias, supporting their mistrust (Dickerson Mayes et al., 2013).

It is therefore also possible that the boys with ASD were suspicious of the truth of the feedback, even when there was no reason to be so. Adults with ASD were found not to benefit when memory stimuli are semantically related (Toichi & Kamio, 2002), even though they may have superior rote memory (DeLong, 2008). Likewise, in the current study, the boys with ASD did not benefit as much from feedback that is true and straightforward.

These are crucial findings, however, one limitation to the study is, that the ASD sample size was relatively small. However, we conducted a comprehensive assessment with a comparably long and computerized task which allowed us to control children’s learning in a very fine-tuned way. We are currently carrying out further research on factors that may be responsible why low and average ability boys with ASD could not benefit as much from completely reliable feedback, yet learned so well under uncertainty.

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Abstract: The purpose of this study was to investigate the effectiveness of a behavioral art program in improving social skills for two children with autism in group settings. A multiple probe design across behaviors was used. The results indicated that for both children, the program increased the percentages of spontaneous verbal communications, presentation of artwork, and eye contact. One of the children showed a concurrent decrease in off-seat behavior. Both children maintained high levels of performance on the target social skills three weeks after the treatment. Social skills were generalized to different settings with another instructor and an unfamiliar audience. The increased scores on both children’s adaptive behaviors indicated that both the teachers and the parents perceived that the art program was effective in improving the children’s social skills.

One of the distinct characteristics of individuals diagnosed with autism spectrum disorders (ASD) is the lack of reciprocal social communications. Such deficits in socialization can be present in these individuals with or without any other cognitive or developmental delays (American Psychiatric Association, 2013). Social impairments in children with ASD can possibly develop with age or improve through natural interactions with others in the environment. As Tantam (2003) pointed out, when children with ASD progress to late elementary and early adolescence, they continue to experience difficulties in an increasingly complex social environment that requires more sophisticated social repertoires and eventually becomes a source of distress. Studies that investigated group interactions in mainstream classrooms reported that students with ASD often express poor social support and were more likely to experience social isolation than their typical peers (Bauminger, 2003; Bauminger & Kasari, 2000). Integrating these individuals with typical peers may increase potential opportunities for social interactions, although it does not automatically improve their social skills unless these skills are specifically targeted and facilitated through adult or peer mediations (Weiss & Harris, 2001). With the number of children diagnosed with ASD rising, it is imperative to develop intervention programs aimed at improving social skills.

Applied behavior analysis (ABA) has offered effective treatment strategies in many areas for individuals with ASD, though the clinical treatments targeting social skills for this population are still in need of more research (Weiss & Harris, 2001). Currently, some of the strategies include arranging motivating operations to teach spontaneous verbal communication in contrived and natural environments (e.g., Endicott & Higbee, 2007), using various prompting procedures to increase joint attention (e.g., Taylor & Hoch, 2008; Whalen & Schreibman, 2003), pivotal response training to facilitate different aspects of social interactions (e.g., Pierce & Schreibman, 1995), using scripts to teach verbal initiations (e.g., Woods, & Poulson, 2006), multiple exemplar training to teach sharing
(Marzull-Kerth, Reeve, & Townsend, 2011), and the video modeling to promote social responses to peers (Jones, Lerman, & Lechago, 2014). It is noted that most research designed to teach social skills involve the use of tangible items or activities, such as preferred toys, objects and activities to facilitate the acquisition of target social behaviors with an adult or peers.

Besides ABA treatment, the application of art therapy to facilitate social skill development for children with ASD has been proposed as an alternative. For example, Cooper and Widdows (2004) speculated that children with ASD who are typically visual and concrete learners can better communicate their feelings, emotions, or desires through art activities that match their learning styles. It is relatively easy to solicit individuals with ASD to participate in art activities because they can express themselves in a way that is more likely to be accepted by their peers, thereby reducing their anxiety of social rejection or problem behaviors (Epp, 2008; Noble, 2001). Many case studies have reported the relationship of art activities and the qualitative improvement of social behaviors for children with ASD (e.g., Elkis-Abuhoff, 2008; Emery, 2004; Kearns, 2004). Epp (2008) used a social skills questionnaire for parents to evaluate the effectiveness of an art therapy group and also reported art therapy as an effective treatment to improve social behaviors for individuals with ASD. Roth (2001) proposed a behavioral approach to art therapy that incorporated several behavioral techniques (e.g., reinforcement, prompts, specific objectives) into the practice of art therapy and found that the process successfully addressed the social and emotional needs for many cases of children with ASD.

Although the above-mentioned studies proposed the possibility of art therapy to improve socialization deficits in individuals with ASD, none of these studies have used experimental designs involving direct and objective measurements of outcome behaviors. The comparison of behaviors before and after the implementation of treatment procedures was either descriptive in nature, based on the observation of the therapists, or rated via indirect assessment that relied completely on parental perceptions (e.g., Epp, 2008). Further, the target behaviors of treatment were not specifically defined for each individual. Very little description was found that informed the reader of each participant’s skill levels. None of them described specific treatment procedures of art therapy being conducted, rendering replications impossible. Despite the speculated advantages and potential usages of art therapy in treating social impairments for individuals with ASD, such a treatment remains more of an art than a science.

Research on embedded instruction suggested that target behaviors can be effectively taught during ongoing activities (e.g., Johnson, McDonnell, Holzwarth, & Hunter, 2004). Johnson et al. (2004) contended that the embedded instruction strategy incorporates structured instruction into daily routines to maximize performance opportunities of target behavior in natural settings. From the literature, it seems possible to embed social skills instruction in art activities to facilitate social skills learning for individuals with ASD; however, research in this area remains limited.

Venn et al. (1993) embedded imitation requests in art activities with time delay prompts, successfully increasing peer imitation behaviors for three children with autism and developmental disabilities. All children in the study demonstrated novel imitation (e.g., fine motor actions) via daily art activities in generalized settings. However, any other forms of social interactions were not targeted in the study.

Ingenmey and Van Houten (1991) instructed a student to draw pictures and tact his drawing (e.g., “I made a sun”) to solicit adult praises. The results showed that the student spontaneously emitted more trained and untrained tacts after the treatment of a time delay prompt procedure. This suggested a possibility of using an art activity as a medium to facilitate relevant verbal communications. The focus of their study only targeted tacts (e.g., description of what was in the picture), but not any other form of verbal operants or verbal exchanges between a listener and a speaker in a social situation. It is necessary to expand the finding of these studies to further examine whether specific social skills training can be embedded into art activities, along with appropriate treatment strategies, to promote
various aspects of social interactions in natural environment for children with social or communication deficits.

Got and Cheng (2008) used a randomized experimental design and found that an art program improved perceived social interactions by parents for individuals with developmental disabilities. The art program consisted of art making activities with various types of art materials, group artwork, and the sharing of artwork and feelings. The use of a group experimental design demonstrated the strength of their study, but the specific procedures of art activities that occurred in these sessions were not described, making replications of their study impossible. Their study also did not include clear descriptions of participants’ skill sets in cognitive and social domains, and the outcome measures used questionnaires instead of direct measures of observations.

Banks, Davis, Howard, and McLaughlin (1993) used a single case experimental design to compare the effects of art activities on direct measures of social behaviors of three children with developmental disabilities. Compared to the control condition where children were simply provided with art materials with general verbal directions (e.g., you have 15 min for this activity), they reported that art activities with instructor’s specific directions resulted in relatively high levels of social initiation with peers and appropriate eye contact and a relatively low level of aggressive behaviors. Their results suggested that directed art activities had positive effects on social behaviors of children with disabilities. Additional empirical evidence, such as systematic replications, is still needed to validate procedures involved in behavior art procedures, resulting in the improvement of social behaviors for individuals with ASD and developmental disabilities.

Even though the studies reviewed above have documented that social skills can be facilitated through various items/activities in conjunction with appropriate behavioral treatment strategies, research has not yet examined the effects of using art activities as medium to facilitate the improvement of socio-communicative skills for individuals with ASD. The purpose of the present study was to validate whether a behavioral art program was effective in increasing social skills for two children with ASD in group settings, including spontaneous verbal communications, presentation of artwork, and eye contact. The concurrent decrease of off-seat behavior for one of the two participants was measured. Parental perception of their children’s adaptive behaviors in the domains of expressive communication, interpersonal relationships, play and leisure time, and coping skills, were measured with the Vineland Adaptive Behavior Scales (VABS) (Wu, Chang, Lu, Chiu, 2004).

Method

Participants

Two 6-year-old boys, Eng and Cheng, were recruited through an announcement posted on the website of a university-affiliated autism treatment center. Eng was diagnosed with an ASD and attention deficit hyperactive disorder (ADHD), and Cheng was diagnosed with an ASD. According to parental reports, both children received their diagnosis by the same pediatric physician in a medical center when they were 3 years old. However, their evaluation records were not required for them to participate in the study. The criteria for recruitment to participate in this study included a) the child must have a diagnosis of ASD, b) the child has basic verbal communication skills, and c) the child is observed to have difficulties in social interactions with others. When registering their child for this art program, the parents were informed the nature and purpose of the study. Appropriate informed consent was obtained from the parents. The experimenter (the first author) also explained the content of art lessons and the requirement of presentations to each child and obtained their assents.

At the time of the study, Eng received a center-based behavioral treatment program for children with autism for 2 hours per day and 2 days per week after school. He attended a public elementary school in a regular education room but was pulled out for 1 to 2 hours daily to a resource room for children with special needs. His verbal skills consisted of following verbal instructions, manding with incomplete sentences, and tacting about 100 objects (i.e., body parts, actions, animals,
food, places). At the time of the study, he could tact four basic emotions (i.e., happy, sad, angry, scared). In the area of intraoral skills, he could answer and ask WH-questions for information (i.e., what, who, where, when). Eng was selected for the study because his teacher reported that he was disruptive in class by leaving his seat frequently, did not communicate effectively with the teacher, was engaged in either repetitive or solitary play activities during free play time, did not have social interactions with peers, and had difficulties talking in public (e.g., show and tell).

Cheng had received behavioral treatment for one year prior to the study. He also attended a public elementary school in a regular education room and received physical therapy, occupational therapy, and speech pathology in a private medical center after school hours during the study. His basic verbal skills included following verbal instructions and tacting more than 100 objects (i.e., body parts, actions, animals, food, places, furniture, and vehicles). He answered and asked WH-questions (i.e., where, what, who, when, which, how). During free play time, he enjoyed playing with all kinds of play mobiles and vehicles. He tacted basic emotions and was learning generalized tacts of emotions under different contexts (e.g., when seeing a boy eating ice cream in a picture, he would say “The boy feels happy because he is eating ice cream.”). He was selected for the study because his parents were concerned that he often expressed his needs and frustration through whining. His teacher also reported that he did not talk or have appropriate social interactions with the teacher and peers, and avoided talking in public (e.g., answering teachers’ questions in class).

Setting and Materials

The study was conducted in a behavioral treatment center affiliated with a university located in a major city in Taiwan. Therefore, all treatment programs were delivered in Mandarin. All sessions were conducted in the classroom of the treatment center. The classroom was 8 m by 2.7 m, and 2 m from floor to ceiling. It contained a play area with toys and books on shelves, two tables with four chairs for treatment sessions, and two video cameras for recording all sessions. Maintenance and generalization sessions were conducted by another therapist in the conference room with the presence of other children and therapists as their audience.

Creative art materials used included crayons, pencils, colored pens, colored pencils, paint brushes, watercolor, poster paint, markers, colored tape, magazines, glue, resin, scissors, pictures, drawing papers, wall papers, corrugated papers, picture books, dolls, boxes, and cartons (see Table 1 for a list of materials used for each session). Each participant was provided with a sheet of drawing paper (54 cm × 39 cm). The behavioral art treatment activities were divided into four themes: creativity, my family, myself, and my summer vacation (see Table 2 for a complete list of target behaviors, activity topics, and themes used under various conditions in this study).

Experimental Design

A multiple probe design across behaviors (Cooper, Heron, & Heward, 2007) was used to evaluate the effects of the behavioral art program. Following the baseline, behavioral art sessions were introduced to treat the target behaviors in the order of verbal communication, presentation of artwork, and eye contact. No reinforcement sessions followed when the target behaviors (verbal communications and presentation of artwork) reached criterion performance. The maintenance and generalization sessions were conducted three weeks after eye contact (last target behavior) reached the criterion. No art activities sessions or other practice opportunities for the target behaviors were offered during treatment sessions during this period of time.

Response Measurement

Direct measures of social skills. The dependent variables were the children’s social skills, including verbal communications, presentation of artwork, and eye contact. A partial interval recording system was used to record each child’s instances of verbal communications. Each one-hour art session was divided into a total of 240 intervals. An instance of
verbal communication was defined as asking relevant questions, making relevant comments, requesting materials, and responding to others’ questions during a 15 s interval. The independent responses were recorded as “+,” prompted correct responses as “p” (counted as “+” in calculation), and no responses or incorrect responses as “−.” For example, during an art session with a topic about animals, when the child spontaneously made a comment, “Elephant is my favorite animal,” this response would be recorded as a “+” for the interval. Similarly, if a child provided an adequate answer (e.g., “elephants”) in response to the instructor’s question (e.g., “What animals do you like?”), it was recorded as a “+.” However, if the child did not respond, or if he responded incorrectly (e.g., “Red”), it was recorded as a “−” for that interval. Only the independent responses were counted as correct, and the prompted responses and no responses were counted as incorrect. For example, when the child did not respond to the question, “What animal do you like?” The instructor would show a page to the child and say, “Wow! The forest is so colorful,” pause for a few seconds, and continue, “See, this animal is doing something special to make the forest so colorful!” If the child still did not comment, the instructor would ask some other questions for the child to respond (e.g., “What is the fox doing?”) or “What else did you see in this

TABLE 1
Art Materials Used in Each Session

<table>
<thead>
<tr>
<th>Session</th>
<th>Activity Topic</th>
<th>Art Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Free creative work</td>
<td>Drawing paper, color pencils, pastel, crayons, colored paper, glue, picture books</td>
</tr>
<tr>
<td>02</td>
<td>Free creative work</td>
<td>Drawing paper, color pencils, pastel, crayons, watercolor, brushes, palette, dollhouse, family dolls, handmade trees, family name cards, Scotch tape</td>
</tr>
<tr>
<td>03</td>
<td>Free creative work</td>
<td>Drawing paper, color pencils, pastel, crayons, watercolor, palette, pictures of facial expressions, stories and videos about emotions</td>
</tr>
<tr>
<td>04</td>
<td>My family tree</td>
<td>Drawing paper, color pencils, pastel, crayons, brushes, watercolor, palette, dollhouse, family dolls, handmade trees, family name cards, Scotch tape</td>
</tr>
<tr>
<td>05</td>
<td>The bubbles in mind</td>
<td>Drawing paper, color pencils, pastel, crayons, brushes, watercolor, palette, pictures of facial expressions, stories and videos about emotions</td>
</tr>
<tr>
<td>06</td>
<td>My dream</td>
<td>Drawing paper, color pencils, pastel, crayons, brushes, watercolor, palette, dollhouse, family dolls, handmade trees, family name cards, Scotch tape</td>
</tr>
<tr>
<td>07</td>
<td>Happy zoo</td>
<td>Drawing paper, pastel, color pencils, crayons, palette, watercolor, palette, non-woven material, picture books</td>
</tr>
<tr>
<td>08</td>
<td>Important things</td>
<td>Drawing paper, color pencils, pastel, crayons, brushes, watercolor, palette, dollhouse, family dolls, handmade trees, family name cards, Scotch tape</td>
</tr>
<tr>
<td>09</td>
<td>A tree buds</td>
<td>Drawing paper, pastel, ink, straws, crepe paper, pigment, palette, glue, picture books</td>
</tr>
<tr>
<td>10</td>
<td>Magic bubbles</td>
<td>Drawing paper, paint, straws, tennis balls, cups, dishes soap, brushes, watercolor, palette, bubble guns, water guns, hair dryers, picture books</td>
</tr>
<tr>
<td>11</td>
<td>The world of ocean</td>
<td>Drawing paper, pencils, color pencils, needle pens, signature pens, picture books</td>
</tr>
<tr>
<td>12</td>
<td>My hands</td>
<td>Drawing paper, pencils, dot stickers, color pencils, pastel, crayon, scissors, colored paper, paste, picture books</td>
</tr>
<tr>
<td>13</td>
<td>My eyes in lines</td>
<td>Drawing paper, pencils, pastel, color pencils, pastel, crayons, wool, hair root, electronic picture books</td>
</tr>
<tr>
<td>14</td>
<td>My legumes face</td>
<td>Drawing paper, beans, pastel, color pencils, pastel, crayons, wool, hair root, electronic picture books</td>
</tr>
<tr>
<td>15</td>
<td>Memory book</td>
<td>Activity slides, pictures, pastel, magazines, glue, scissors, twin adhesive tape, cardboard, glitters, decorations, wrapping paper, elastic</td>
</tr>
<tr>
<td>16</td>
<td>Shiny summer</td>
<td>Drawing paper, pictures, pastel, brush, palette, watercolor, palette, ruler, scissors, twin adhesive tape, colored paper</td>
</tr>
<tr>
<td>17</td>
<td>The mask</td>
<td>Art masks, pigment, brushes, palette, decorations, elastic, picture books</td>
</tr>
</tbody>
</table>
---

**An instance of eye contact was defined as looking at another person’s face for at least 3 s when talking to that person during the entire session. The percentage of eye contact was calculated by dividing the number of eye contact by total opportunities of eye contact and multiplying by 100. An opportunity for an eye contact was defined as a situation where the child talked to another person or an audience, asked for materials, made a comment, or answered questions of another person. When an audience was present, the child was required to look at least one person for 3 s in order to be scored as a correct response.**

**Indirect measure.** The parents’ and teachers’ perception of students’ improvement in adaptive behaviors was measured with the VABS (Wu, et al, 2004). The children’s parents and school teachers were interviewed with the VABS before the onset and after the completion of the study. The scores of parents and teachers were averaged for each child. Parents were informed of the nature of the study via the parental informed consents obtained prior to the study, whereas the school teachers were not aware of the nature of the study.

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**TABLE 2**

<table>
<thead>
<tr>
<th>Session</th>
<th>Condition/Target Behavior</th>
<th>Activity Topic</th>
<th>Theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Baseline</td>
<td>Free creative work</td>
<td>Theme 1: Creativity</td>
</tr>
<tr>
<td>02</td>
<td>Treatment/Verbal communication</td>
<td>My family tree</td>
<td>Theme 2: My family</td>
</tr>
<tr>
<td>03</td>
<td>Treatment/Verbal communication</td>
<td>The bubbles in mind</td>
<td></td>
</tr>
<tr>
<td>04</td>
<td>Treatment/Verbal communication</td>
<td>My dream</td>
<td></td>
</tr>
<tr>
<td>05</td>
<td>Treatment/Verbal communication</td>
<td>Happy zoo</td>
<td></td>
</tr>
<tr>
<td>06</td>
<td>Treatment/Verbal communication</td>
<td>Important things</td>
<td></td>
</tr>
<tr>
<td>07</td>
<td>Treatment/Verbal communication</td>
<td>A tree buds</td>
<td>Theme 3: Myself</td>
</tr>
<tr>
<td>08</td>
<td>Treatment/Verbal communication</td>
<td>Magic bubbles</td>
<td></td>
</tr>
<tr>
<td>09</td>
<td>Treatment/Verbal communication</td>
<td>The world of ocean</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Treatment/Verbal communication</td>
<td>My hands</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Treatment/Verbal communication</td>
<td>My eyes in lines</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Treatment/Verbal communication</td>
<td>My legumes face</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Treatment/Verbal communication</td>
<td>Memory book</td>
<td>Theme 4: Review of my art work</td>
</tr>
<tr>
<td>14</td>
<td>Treatment/Verbal communication</td>
<td>Shiny summer</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Generalization</td>
<td>The mask</td>
<td></td>
</tr>
</tbody>
</table>
Inter-observer Agreement and Procedural Integrity

All sessions were videotaped for the purposes of data collection, inter-observer agreement, and procedural integrity. To assess inter-observer agreement and procedural integrity, a second observer (a graduate student) who was naïve to the purpose of the study was trained to record data from the videotapes independently and separately from the experimenters. The data of agreement on all target behaviors and procedural integrity were collected for 35% of the total sessions, and randomly distributed across conditions. For inter-observer agreement, the agreement on correct responses and incorrect responses was assessed by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. The agreement averaged 93.3% with a range from 82.3% to 100%. The assessment of procedural integrity was conducted by a second observer from videotapes using a checklist (see Table 3). Each accurate implementation was checked under Y, while an inaccurate implementation or omission was checked under N. The percentage of integrity was calculated by dividing the number of checks on Y by the number of checks on Y plus checks on N and multiplying by 100. The data on procedural integrity were 100% for all sessions observed.

Procedure

Baseline. During each baseline session, the experimenter introduced the topic, asked questions to make certain the participants understood the instruction, arranged necessary materials for the artwork, waited for the participants to complete the work, and asked them to show their work to the audience (two other instructors and three to five children in the center). General social praise for appropriate behaviors (e.g., “Good job”) was provided throughout baseline sessions. If the students spontaneously asked questions or made comments, the instructor would answer their questions or make general comments (e.g., “Yeah, that is good.”) After they completed the work, the instructor would say “Let’s show your work,” without specific instructions, but delivered general praise for appropriate behaviors.

Intervention—the behavioral art program. The independent variable consisted of a behavioral art program, which incorporated behavioral tactics throughout the art sessions. The behavioral tactics involved in the package included (a) manipulation of motivating operations (MOs), (b) implementation of a token economy, and (c) use of prompting procedures. The sequence of behaviors targeted in the multiple probes across behaviors design was (a) verbal communications, (b) presentation of artwork, and (c) eye contact.

Each art session lasted 60 min, which contained (a) a warm-up activity (15 min), (b) work time (35 min), and (c) presentation of artwork to another participant and/or to the general audience (10 min). In the beginning of each treatment session, the instructor intro-
duced the topic with a warm-up activity by telling a relevant story or introducing an activity, asking questions, and inviting the participants to engage in the activity. She then presented the art materials and guided the participants to use the materials. For example, during the “My family tree” activity, the instructor presented a dollhouse with various rooms and figures representing family members. The participants were invited to introduce the family members of theirs using the figures and the items in the dollhouse and were asked what activities they would typically do in different rooms of their houses. After that, the instructor presented the materials, demonstrated how to use the materials, and let the participants practice using the materials.

The first author created all art lesson plans in references of Davalos (1999), Flowers (1992), and Houl (2011). Interested readers can refer to these books for ideas of various types of art activities. Specific procedures for each lesson can also be obtained upon request from the corresponding authors.

The first target behavior was to increase the number of spontaneous verbal communications. The MOs arranged to increase the occurrences of verbal communications included (a) withholding the materials necessary for tasks, (b) presenting the materials unfamiliar to the children without showing how to use them, and (c) looking at one of the children and making relevant comments on the given topic. Each instance of MO manipulation was defined as an opportunity to have a verbal communication, and the instructor created a total of 20 opportunities for each child for each session during warm-up and work time. During these opportunities, the children were told to start working without necessary materials (e.g., “Go ahead and start your creation!”), or given unfamiliar materials without being shown how to use them (e.g., “Use these things for your creation!”). If the child did not respond, the instructor would provide verbal prompts (e.g., “What do you need?” or “What happened in the forest?”). If the child asked for materials or how to use them, the instructor delivered them immediately; if not, the instructor would give partial echoic prompts (e.g., “I want . . .” or “How to . . .?”). When the child spontaneously responded to the instructor’s verbal comments, the instructor would give specific verbal feedback (depending on the child’s responses) and deliver a token. However, if the child responded with any verbal prompts, the instructor would deliver specific feedback, but no tokens. All responses occurred under MOs as well as verbal prompts were recorded as “p” and counted as “−” in calculation of percentages of correct responses. However, spontaneous responses occurred under MOs were recorded as “+. ”

The second target behavior was presenting the artwork to a group of three to five people following a five-step instruction. During treatment, the five steps were initially presented with five individual textual cards with written directions as prompts. If the child followed each step in his presentation, the instructor would provide verbal praise specifically for each step along with a token after the presentation. If the child failed to follow the five steps, the instructor would deliver a correction trial for each step omitted at the end of the presentation. A token was dispensed immediately for each child following the presentation, regardless of their performance.

The third target behavior was eye contact during the entire art session. During treatment, the instructor first looked at the child, talked to him, and waited for 3 s for the child’s verbal response along with eye contact. If the child verbally responded with appropriate eye contact within 3 s, the instructor made relevant comments and delivered social praise on eye contact along with a token. If the child verbally responded without eye contact, the instructor ignored the child initially, waited 3 s, and then gave the same antecedent as well as a gestural prompt (i.e., pointing with an index finger to direct the child’s eye contact to the instructor), and made comments. The same procedure was in effect when the child spontaneously made a verbal request or comment but failed to look at the instructor when doing so. Note that eye contact was not required during the treatment of verbal communications and presentations.

No reinforcement. The no reinforcement phase was implemented immediately following the mastery of verbal communications and artwork presentations but was not implemented after eye contact due to time constraints. During this phase, the MOs were
identical as in the treatment, but the instructor did not deliver any prompts or tokens for children’s verbal responses. General social praise was provided for appropriate behaviors. Similar to the treatment phase, responses occurred under contrived MOs were recorded as “-.” It was noted that children’s spontaneous verbal responses tended to be evoked by the novelty of the materials without contrived MOs during this phase.

**Maintenance and generalization.** Generalization across a different instructor and in another setting was conducted three weeks following the no reinforcement phase with an identical procedure as in the no reinforcement phase. The sessions were conducted by another instructor and two other children unfamiliar to the participants in the conference room of the center. The instructor was in the same graduate program as the experimenter (the first author), who has also completed one-year course requirement and supervision in the ABA center. The conference room had an oval-shaped table with 10 seats and a screen projector without any toys or a play area.

**Results**

Figure 1 and Figure 2 depict the percentage of correct responses across three target behaviors for Eng and Cheng, respectively. The range and mean percentage of correct responses for target behaviors across conditions are summarized in Table 4. Both Eng’s and Cheng’s figures display a similar pattern: The percentage of correct responses was relatively low in baseline, increased and achieved criterion performance at a relatively high level, decreased slightly initially but gradually increased to a relatively high level during no reinforcement, and remained at a high level during follow-up maintenance and generalization sessions. For verbal communications, the percentage of correct responses was relatively low in baseline, increased after treatment was introduced, remained at the same level during no reinforcement phase with an increase at the end, and maintained at a high level during follow-up sessions. Data on artwork presentations during baseline were at a low level, but both children performed at a high level during treatment and remained at high levels after treatment during no reinforcement and follow-up sessions. The percentage of eye contact was also relatively low in baseline, but increased to a high level during treatment and maintained during follow-up sessions.

Figure 3 displays duration (min) of off-seat behavior for Eng across conditions. During baseline, his off-seat behavior was between 15 to 18 min per session, but significantly decreased to a low level of zero to less than one min once treatment was introduced and remained zero during follow-up sessions.

Figure 4 displays the pretest and posttest scores of the VABS for Eng and Cheng, respectively. Scores are reported for only four sub-domains that are related to the target social behaviors in this study—expressive communication, interpersonal relationships, play and leisure time, and coping skills. Both children’s scores were increased after the completion of the art program, suggesting improvements in their adaptive skills in these domains. Eng’s scores in all four sub-domains increased from 39 to 47 in expressive communication, from 21 to 24 in interpersonal relationships, from 20 to 27 in play and leisure time, and from 8 to 20 in coping skills. Cheng’s scores also increased in all sub-domains assessed, from 45 to 50 in expressive communication, from 17 to 19 in interpersonal relationships, 15 to 26 in play and leisure time, and from 9 to 18 in coping skills.

**Discussion**

Many students with ASD have been placed in regular education classrooms for the purpose of fostering social interactions in order to alleviate their deficits in this important area. It is, therefore, imperative to develop programs that facilitate social interactions in group settings. ABA has developed and validated various effective treatment strategies of socio-communicative skills for these individuals with ASD, and the results suggested the possibility of embedding social skills instruction into art activities. Advocates of art therapy have also proposed art therapy as an alternative to improve social skills for individuals with ASD. Although successful cases have been reported with a behavioral approach to art ther-
apy (i.e., Roth, 2001), the descriptions of these cases did not include specific treatment procedures as well as social behaviors improved as a result of therapy.

The present study was the first attempt to empirically investigate the effectiveness of a behavioral art program designed specifically to improve three particular socio-communicative deficits for two children with ASD—verbal communications, presentation of artwork, and eye contact. The results indicated that the program is effective in improving all three target social behaviors for both children in group settings. During baseline, all
three behaviors were present but at relatively low levels, suggesting art activities alone did not increase these behaviors. However, after the treatment, which incorporated behavioral tactics targeting specific skills, both children were able to increase spontaneous target responses to relatively high levels.

Specifically, the percentage of spontaneous verbal communications was increased during treatment with the arrangements of MOs, social praises, and tokens. During the no
reinforcement phase, MOs were still arranged, social praise was provided to general attending behaviors, and tokens were not distributed to reinforce verbal communications. Despite a slight decrease in the beginning of the no reinforcement phase, both children’s verbal communications gradually increased to a high level during this phase and maintained at that level during follow-up sessions. Observations from the videotapes showed that both children’s verbal communications were exclusively limited to the instructor, relying on the MOs and partial echoic prompts, while they began to engage in brief conversations with each other (e.g., obtaining materials or making comments to another child) during the no reinforcement phase. It is probable that, for these two children, verbal communications may initially require MOs along with artificial contingencies (e.g., tokens), but once the skill is acquired, it can be maintained with natural contingencies and generalized to a peer. In other words, “true” social exchanges have occurred in these two children because one child spontaneously

<table>
<thead>
<tr>
<th>Sessions/Target Behaviors</th>
<th>Baseline</th>
<th>Intervention</th>
<th>No Reinforcement</th>
<th>Maintenance/Generalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eng</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal communication</td>
<td>28.3 (25–33)</td>
<td>49.3 (40.8–64.1)</td>
<td>40.9 (32.6–55)</td>
<td>60.3 (54.1–66.6)</td>
</tr>
<tr>
<td>Presentation M (range)</td>
<td>20 (20–20)</td>
<td>90 (60–100)</td>
<td>95 (80–100)</td>
<td>100 (100–100)</td>
</tr>
<tr>
<td>Eye contact M (range)</td>
<td>21.1 (14.8–28.1)</td>
<td>69.3 (61.1–77.4)</td>
<td>74.4 (72–76.9)</td>
<td></td>
</tr>
<tr>
<td>Cheng</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal communication</td>
<td>37.6 (35–40)</td>
<td>50.2 (42.8–61.5)</td>
<td>50 (34.7–78)</td>
<td>60.3 (58.2–62.5)</td>
</tr>
<tr>
<td>Showing M (range)</td>
<td>12 (0–20)</td>
<td>95 (80–100)</td>
<td>100 (100–100)</td>
<td>100 (100–100)</td>
</tr>
<tr>
<td>Eye contact M (range)</td>
<td>43.9 (40.9–48.1)</td>
<td>92.1 (84–96.8)</td>
<td></td>
<td>88.3 (84.6–92)</td>
</tr>
</tbody>
</table>

Figure 3. Duration (Min) of off-seat behavior during art sessions for Eng.
initiated an opportunity of communication, and another peer’s response has become reinforcing to such an initiation. Despite the phenomenon observed, the present study is limited because student’s communication with one another was not formally taught and measured, thus, it is in need of further investigations.

The artwork presentation skill was soon acquired through textual prompts in conjunction with behavioral art programs.
tion with token delivery. The data observed suggest that both children not only acquired the skill to follow a five-step written direction, but, more importantly, they have acquired the skill to speak in front of an audience. The presentation skill was further enhanced with the introduction of the third target skill—eye contact—by requiring the children to look at the audience while speaking. Both children’s school teachers were very impressed with the children’s presentations because they had refused to participate in any activities in class involving public speaking prior to the study.

Similarly, eye contact for both children did not occur at a high level before treatment was implemented. In the beginning of the treatment, both children required gestural prompts and artificial contingencies (e.g., tokens) to acquire appropriate eye contact to the instructor and the audience. When they were observed to have spontaneous eye contact to the listener, the instructor would provide a token along with social praises for their eye contact. During the no reinforcement and follow-up sessions, their eye contact was maintained without artificial contingencies.

The study also extends current literature by incorporating behavioral tactics into art activities with direct measures of social skills for two children with ASD. We used various art activities embedded with behavioral tactics to increase spontaneous mand and intraverbal behaviors in group settings. Banks et al (1993) asked therapeutic questions (e.g., “How did you feel?”) while the children in their study engaged in art activities and found the children’s social behaviors improved after treatment. We included instruction targeting social skills through art activities. Thus, our study focused on improving social skills through art activities instead of using art for the purpose of psychotherapy. Overall, the results of the study suggest that it was effective to utilize art activities embedded with behavioral tactics targeting specific social skills for both children. Once these target skills were acquired, art activities alone could function to maintain acquired social skills and potentially facilitate generalizations of these skills to natural social interactions with peers in school settings.

The findings of this study have particular social and educational significance for the learning of social behavior for these children. It is suggested that specific social skills can be acquired through art activities in order for the children to engage in social interactions with an adult or peer in group settings. Simply placing them in a social situation without individualized instructions targeting specific social skills did not result in the “natural” occurrence of such skills (e.g., baseline).

For Eng, his off-seat behavior observed frequently during baseline was decreased to a low level with zero occurrences in most sessions after the treatment was introduced. Cheng did not have this particular problem behavior. The decrease of Eng’s off-seat behavior is an incidental finding, as the disruptive behavior was not planned, and the data were recorded from videotapes after the completion of the study. Although only AB data are available, we speculate that this is a collateral gain of the behavioral art program due to either the reinforcing value of the art activities or adult attention given during treatment. It is also possible that once the verbal communication skill was acquired, individual attention from the instructor may be withdrawn, and the potential source of reinforcement came from social interactions with another peer or the art activities themselves. However, further research is necessary to empirically examine these variables.

Scores of VABS indicated that parents and school teachers perceived that the children’s social skills improved after the art program. The school teachers also reported that the children have been observed to engage in art activities in art class and were willing to share their artwork with the entire class during show and tell time. These anecdotal reports suggest that their presentation skills have been generalized to school settings. However, the generalization effect should be empirically tested for future studies.

The results of this study provide an empirical support of using art activities embedded with behavioral tactics to improve social skills for two children with ASD. However, more research is needed. For example, future studies could investigate whether a behavioral approach to art program can be applied to other group settings, such as in regular classrooms with students with ASD or ADHD. Other areas...
of social deficits or problem behaviors displayed by some individuals with ASD can also be addressed with specific instructional tactics targeting these skills while doing art activities. Furthermore, generalization of adult-child interactions to child-child interactions can be planned as part of the treatment for future research.

References


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Parent Implementation of RECALL: A Systematic Case Study

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Abstract: This systematic case study utilized a repeated acquisition design to investigate the impact of a caregiver-implemented RECALL (Reading to Engage Children with Autism in Language and Learning) on the correct, unprompted responses of a young child with autism spectrum disorder (ASD). RECALL is an adapted shared reading intervention that includes a least to most prompting hierarchy, visual supports, and additional instructional supports known to enhance the learning of children with ASD. Following training, the caregiver implemented RECALL with her child for 6 weeks, and results showed that the child improved his correct, spontaneous responding, and that the caregiver was able to implement RECALL with integrity. Positive maintenance and social validity data are also reported.

Foundational to autism spectrum disorder (ASD) are difficulties developing joint attention, social reciprocity, and language/communication (ASHA, 2006). These challenges place children with ASD at risk for future reading failure, especially in the area of comprehension (Mundy, Mastergeorge, & McIntyre, 2012). That is, the problems children with ASD experience acquiring reading skills have been linked to language development (Brown, Oram-Cardy, & Johnson, 2013; Lucas & Norbury, 2014; Nation, Clarke, Wright, & Williams, 2006) and social communication (Jones et al., 2009; Ricketts, Jones, Happe, & Charman, 2013). Therefore, it is essential that early intervention for children with ASD emphasize the emergent literacy skills necessary for future reading development (ASHA, 2006; Kaiser, Roberts, & McLeod, 2011).

Shared reading interventions may be one way to target the communication challenges that influence the future reading development of children with ASD, as meta-analyses documenting the impact of shared reading interventions on the language skills of young children report moderate effect size gains in oral language and expressive/receptive vocabulary (Mol Bus, & de Jong, 2009; NELP, 2009). Therefore, it is possible that targeting emergent literacy skills through shared reading in the early years may limit later comprehension problems (Cain & Oakhill, 2007).

Three studies have targeted shared reading for preschool children with ASD (Bellon, Ogletree, & Harn, 2000; Fleury, Herriott Miramontez, Hudson, & Schwartz, 2014; Whalon, Martinez, Shannon, Butcher, & Hanline, 2015). Following participation in shared reading interventions, children with ASD have increased their spontaneous verbalizations (Bellon et al., 2000; Fleury et al., 2014; Whalon et al.) and correct responding (Whalon et al.). Dialogic reading (DR) is a shared reading intervention that specifically addresses the language skills that influence later reading comprehension (Hogan, Bridges, Justice, & Cain, 2011). The What Works Clearinghouse identified DR as a promising intervention for children with language disorders (WWC, 2010), and Swanson and colleagues (2011) found DR studies provided more causal evidence than other shared reading interventions with moderate to large effects on a number of measures including vocabulary and comprehension. The instructional components of DR facilitate an interactive dialogue about text (Pentimonti, Justice & Piasta, 2013). That is, in DR, books are repeatedly read and the adult asks questions, adds information (expansions), prompts the child to elaborate comments/responses, and provides praise. Fleury and colleagues found that DR improved the verbal participation of children
with ASD, and children regularly responded to questions, but not all question types (Fleury, et al., 2014). To fully engage in language and literacy interventions, many children with known disabilities such as ASD will require additional instructional strategies and supports (Kaiser et al., 2011).

Reading to Engage Children with Autism in Language and Learning (RECALL) is an adaptation of DR (Whalon, Hanline, & Delano, 2013). RECALL combines the prompts and instructional sequence found in DR (Whitehurst et al., 1994) with systematic instructional procedures shown to support the learning of children with ASD (See Wong et al., 2015) including visual supports, prompts to promote joint attention (e.g., Look! while pointing to the book and gazing back at the child; intentional pause while looking expectantly at the child just before or immediately after turning a page), and least-to-most prompting hierarchy. After participating in RECALL, four 4-year-old children with ASD and varying levels of expressive language ability increased their correct, spontaneous responding to fact- and inference-based questions, and 3 of the 4 children with ASD increased the frequency of their initiations (Whalon et al., 2015).

Currently, there are no studies investigating caregiver implementation of shared reading interventions with young children with ASD. This is unfortunate as literacy experiences children have within their homes influence early emergent literacy skills as well as later literacy skill development (Senechal & LeFevre, 2001). Findings from a research synthesis showed engagement in parent-child shared reading is positively related to language and literacy skills of 18 to 63-month old children with and without disabilities (Dunst, Valentine, Raab, & Hamby, 2013). Further, a meta-analysis that included studies involving young children with and without disabilities found that early expressive language development was facilitated by parent-mediated joint reading strategies that promoted children’s active participation in book reading. Strategies included, for example, open-ended questions, attention-getting, and positive feedback (Trivette, Dunst, & Gorman, 2010). Other studies have shown that parents who promote children’s language development during shared reading foster more advanced language development in their children (e.g., Karrass & Braunart-Rieker, 2005; Sénéchal, 1997, Valdez-Menchaca & Whitehurst, 1992). Of particular interest to young children with ASD, parent-child reading can be adapted to meet an individual child’s abilities and intervention goals (Kaderavek & Justice, 2002), allowing for intervention to occur in the child’s natural environment.

Therefore, the purpose of this systematic case study was to determine: (1) the impact of caregiver-implemented RECALL on the percentage of correct, unprompted responses of a child with autism; and (2) the extent to which a caregiver is able to implement RECALL procedures with fidelity.

Method

Participants and Setting

The participating mother and child dyad was recruited from a southeastern United States agency that provides direct services to families of children with ASD. Jayden was a 4-year-old male diagnosed with autism by the local school district. Prior to the study, Jayden received special education services in a preschool self-contained classroom for young children with ASD. To estimate Jayden’s current level of language, the Preschool Language Scales 5th Edition (PLS-5; Zimmerman, Steiner, & Pond, 2010) was administered. Jayden scored a 63 (mean of 100 and SD of 15) on the Auditory Comprehension and a 69 on the Expressive Communication subtests, and his Total Language Score was a 64; thus, Jayden scored greater than 1 SD below the mean on both subtests and the composite language score. In addition, the Test of Preschool Early Literacy (TOPEL; Lonigan, Wagner, Torgesen, & Rashotte, 2007) was given to describe Jayden’s early literacy skills (mean 100 and SD of 15). Jayden’s Early Literacy Index was an 87. His scores on the Print Knowledge (102) and Phonological Awareness (99) subtests were both in the average range, and his score on Definitional Vocabulary was 70. The Gilliam Autism Rating Scale 3rd edition (GARS-3; Gilliam, 2013) was completed with Jayden’s mother, and the Autism Index was 109, indicating the probability of ASD was very likely.
Jayden lived with his mother, father, maternal grandmother, aunt, uncle, and younger sister. Jayden’s mother, Jessica, served as the intervention agent. Jessica was a 26-year-old white/American Indian female. When asked Jayden’s race, his mother reported white, black, and American Indian. Both Jessica and Jayden’s father graduated from high school, and his father completed some college. Jessica was employed as a house cleaner; his father, as a cook. Jayden’s parents identified the household income as between $25,000-34,999 a year. Prior to the study, Jayden’s mother reported that she read aloud and worked on Jayden’s sight word recognition for approximately 30 minutes a day. Jessica stated that she decided to participate in RECALL to better prepare Jayden for kindergarten. All testing and intervention sessions occurred in Jayden’s home during the summer between preschool and Jayden’s first year of kindergarten.

Study Design

A repeated acquisition design (RAD; see Butler, Brown, & Woods, 2014; Dennis, in press; Spencer et al., 2012) was employed to show replication over time by measuring the same skill (i.e., responses to comprehension questions) with different response sets. This design was useful in monitoring the impact of repeated readings over time by collecting pre-test (after an initial reading) and post-test data (after three readings with the caregiver) for each reading. The RAD shows repeated demonstration of comprehension by comparing pre- and post-test responses from each book introduced. Instead of a repeated baseline, pre- and post-test data from each book read illustrates Jayden’s ability to respond to comprehension questions over time. Jayden’s correct responses across books were used to establish a functional relationship between the independent (i.e., RECALL) and dependent variable (i.e., responses to comprehension questions). Although only one child participated in this study, SCRD quality indicators were considered by ensuring at least 5 demonstrations of an effect (See Horner et al., 2005; Kratochill et al., 2010).

Data Collection

All data collection sessions were videotaped and coded. The dependent variable was the percentage of unprompted correct responses on comprehension monitoring probes. The third author administered the probes. Probes consisted of open-ended, fact-, and inference-based questions. Fact-based questions included those focused on vocabulary (e.g., “What animal is this?”) and immediate recall (e.g., “What do dragons love?”). Inference-based questions targeted motivations (e.g., Why is the boy throwing away all of the salsa?), distancing (e.g., Dragons love tacos. What is something you love?), or emotion (e.g., How do you think the dragons are feeling?). The number of fact-based questions asked (n = 6-8) depended on the number of opportunities to respond to questions per book (range 15-17). The number of open-ended (n = 3) and inference-based questions (n = 6) remained constant. The first and third authors wrote the probes and reached consensus on question types (e.g., fact, inference, open-ended) prior to administering each probe.

When administering the probes, the third author read the book aloud and, prior to turning the page, asked a scripted comprehension question. When Jayden responded correctly, the researcher confirmed his response and provided praise. If Jayden responded incorrectly, the researcher stated the correct response.

Unprompted, correct responses were coded when the child spontaneously (i.e., without an adult prompt) responded to a question within a 5-second interval, and the response was related to the book. Administration of comprehension monitoring probes was the same across conditions. During baseline, the probe occurred during an initial reading with the third author. During intervention, the pre-test probe was administered prior to the implementation of RECALL, and the post-test probe following three parent-implemented RECALL sessions. That is, Jayden’s responses to questions during an initial reading with the researcher were compared with his responses after receiving RECALL for three days.
Procedure

Baseline. A baseline phase consisted of three readings from three different books to determine Jayden’s current level of correct responding to comprehension questions. Baseline consisted of the comprehension monitoring probe procedures described under data collection.

Materials. Books in each phase were of similar length in pages (15-17 pages) and number of words per page, included pictures that illustrated content, and provided an opportunity to ask questions about character emotions (A list is available from the first author upon request.). Jessica was given a large Ziploc bag containing the book and question cards with a typed scripted question for each page and three visual options created with Boardmaker®. For each book, three separate sets of question cards were provided for use over three days. Day 1, Day 2, and Day 3 cards were separated, laminated, and bound with a metal ring (see Figure 1). All visual options were possible given the context of the question, but only one answer was correct. Questions were created by the first and third authors to ensure all prompt types were represented.

Intervention. Following baseline and prior to the intervention, Jessica participated in two 30-minute RECALL training sessions. Jessica was shown videos of the researchers modeling the procedures and role-playing occurred until she achieved 100% accuracy on a RECALL treatment fidelity checklist.

The scripted questions asked during RECALL sessions (i.e., intervention) differed from pre- and post-test probes, but included the same number of fact, inference, and open-ended questions, and included all question prompt types (see Table 1). RECALL embeds an adapted DR instructional sequence, PEEP: prompt, evaluate, expand, and praise. That is, if Jayden responded incorrectly following an initial prompt, Jessica initiated a 4-level prompting hierarchy (See Whalon et al., 2015.). First, three visual response options were provided. If Jayden failed to respond or responded incorrectly, Jessica covered one option and a binary choice was presented. Next, if Jayden failed to respond or responded incorrectly, Jessica directly modeled the correct response, and asked Jayden to repeat it. If Jayden did
Jessica also elaborated and praised unprompted and prompted correct responses. To facilitate interaction and participation, Jessica used secure attention prompts and intentional pauses. The secure attention prompt was used to establish joint attention (e.g., “Look!” pointing to the book). A blue sticker dot with the letter “J” written in the middle was placed on the scripted question cards corresponding with pages that show action/emotion in the illustration. Jessica was not limited to 3 secure attention prompts, and was told that she could use them to gain attention when she felt Jayden was beginning to lose interest. To encourage an initiation, Jessica provided an intentional pause. At three different points just before/after turning a page, Jessica looked expectantly at Jayden for 3–5s. A red sticker dot with an “I” written in the middle was placed on three scripted question cards corresponding to pages with climatic parts to remind Jessica to intentionally pause.

Jessica received a short manual with examples of the RECALL prompting hierarchy and elaborations (e.g., “That’s right, Pete is riding a skateboard. Pete has a red skateboard.”). Throughout intervention, researchers watched the videos and provided Jessica with feedback through weekly emails and pre-post-testing visits. Feedback was specific to consistencies/inconsistencies with RECALL procedures.

Maintenance. Following intervention, the third author re-read one of the books taught during intervention and administered the same pre/post comprehension monitoring probe to determine if Jayden’s gains maintained. Books from week 2, 4 and 6 were read one, two, and three weeks following intervention, respectively.

Social validity. Following the intervention, Jessica was interviewed regarding her perceptions of the intervention. Specifically, interview questions asked for Jessica’s perceptions related to the impact of RECALL on literacy and language skills, the strategies she employs while reading, and how her reading aloud has changed since participating in RECALL. Jessica’s responses were audio-recorded and transcribed. These responses were summarized to capture her perceptions related to each question.

Treatment fidelity. Treatment integrity data were collected on 80% of the sessions. Jessica averaged 93% on a treatment integrity checklist (75-100%). Interobserver agreement was calculated for a randomly selected 53% of the videotaped sessions and agreement averaged 97% (89-100%). Checklist items included the consistency with which Jessica asked scripted questions, provided expansions, initiated the prompting hierarchy, and offered praise. Con-

<table>
<thead>
<tr>
<th>Question Prompt</th>
<th>Definition</th>
<th>Example</th>
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<tbody>
<tr>
<td>Recall</td>
<td>Ask about events/details from the story.</td>
<td>“What did Pete put on?” “What did Cookie knock over?” “What are they building?”</td>
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<tr>
<td>Open-Ended</td>
<td>Ask the child to explain what is happening on a page.</td>
<td>“What’s happening?”</td>
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<tr>
<td>Wh-questions</td>
<td>Ask child to identify “what” a specific object, animal, or item is in the story.</td>
<td>Points to an animal/object/item and asks: “What animal is this?” “What shape is this?” “What is he wearing?”</td>
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<tr>
<td>Distancing</td>
<td>Ask the child to relate details from the story to experiences.</td>
<td>“Pete is at the beach, what do you like to do at the beach?”</td>
</tr>
<tr>
<td>Wh-Inference</td>
<td>Ask for a prediction, emotion identification, or motivation.</td>
<td>“What do you think will happen next?” (only on day 1) “Why is the boy throwing away the salsa?” “How do you think Gus feels?”</td>
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sistency was defined as 80% of opportunities. Additional checklist items documented whether Jessica gave at least 4 joint attention prompts, intentionally paused 3 times, made the visual supports available, and ensured Jayden could see the book/illustrations throughout the reading. Jessica demonstrated the greatest variability in her application of expansions. Jessica provided expansions at an acceptable level (80% of opportunities) in 67% of the sessions. Jessica consistently asked scripted questions, and implemented instructional procedures (e.g., prompting hierarchy, praise, secure attention prompts, intentional pauses; 80% of sessions), and reliably ensured the visuals and the book were visible to Jayden (100% of sessions).

In weekly self-evaluations, Jessica rated how consistently and to what extent she was comfortable administering RECALL on a scale of 1 (inconsistently; uncomfortable) to 10 (consistently; comfortable). Jessica indicated that she consistently asked scripted questions, presented the visuals, and kept the book in view of the child. On average, Jessica reported implementing the intervention procedures consistently (average 7.5-8.5) and comfortably (average 7.2-8.3). Jessica noted becoming increasingly more comfortable with expansions over time, which is consistent with treatment integrity data showing greater consistency in later sessions. Although Jessica routinely implemented the prompting hierarchy and intentional pauses with integrity, her ratings increased over time (from 6 in early sessions to 8/9 in later sessions).

Interobserver Agreement (IOA)

Two coders (i.e., the first author and a graduate assistant) used the dependent variable coding scheme to code videotapes of a prior RECALL study. Coders viewed the videos until they reached a minimum of 80% agreement on 3 out of 5 consecutive videos. Once reliable, a randomly selected 75% of sessions from each phase were coded for IOA. Reliability was calculated by dividing the number of agreements by the number of agreements plus the number of disagreements and multiplying by 100. IOA for responses averaged 95% (81-100%).

Data Analysis

The number of correct, unprompted responses at pre- and post-test for each book are displayed in Figure 2. Data were analyzed visually, and the nonoverlap of all pairs (NAP) was calculated. NAP is one of few complete non-overlap indices as it uses all available data points. NAP is a pairwise comparison of all data points that show improvement (Pos), decline (Neg), or no change (Tie): (Pos+.5XTie)/#Pairs (See Parker, Vannest, & Davis, 2011).

Results

Figure 2 illustrates the data collected across phases. In baseline, Jayden’s percentage of unprompted correct responses on comprehension probes ranged from 19-25% with an average of 21% unprompted, correct responses. Figure 1 shows immediate gains in the percentage of unprompted correct responses from pre- to post-test. The average percentage of unprompted correct responses rose from 30% (19-41%) on pre-tests to 54% (44-73%) on post-tests. In the maintenance phase, data suggest Jayden maintained or exceeded intervention levels with a percentage of unprompted correct responding of 66% (59-71%). NAP was 1.0 suggesting no overlap between pre- and post-test scores. Although Jayden’s post-test scores were consistently higher than pre-test, Jayden began to improve on his pre-tests over time.

Table 2 provides the average percentage of Jayden’s unprompted correct responses to fact, inference, and open-ended questions across phases. Jayden’s percentage of unprompted correct responses improved from pre-test averages of 33% of fact, 17% of inference, and 39% of open-ended responses to 72% of fact, 33% of inference, and 67% of open-ended. Jayden maintained his gains on fact and open-ended responses (74% and 67% respectively), and showed greater improvement when responding to inference-based questions (average 56% unprompted correct responses) in the maintenance phase.

Social validity. When asked about the impact of RECALL on Jayden’s language and literacy skills, Jessica noted that RECALL “...sparked something in him to want to learn
more about reading and words.” She perceived a difference in Jayden’s vocabulary following RECALL noting, “...his vocabulary has expanded a great deal since starting RECALL.” She stated that she still reads with Jayden at least twice a day, and that her reading habits changed after participating in RECALL: “Before when we read to him we just read to him. We didn’t really realize how much those questions lay the foundation for so much more.” Jessica now asks “...more questions about what is going on in the story.” In addition, she consistently asks about emotions because this continues to be a “weakness” for Jayden. Jessica also noted changes in Jayden’s behavior when she reads. She has noticed he is asking more questions and is “reading with you and pointing to the words.” In general, she saw that Jayden wants to be “more involved” when she reads aloud. Jessica said that she and Jayden “really enjoyed” RECALL.

Discussion

This preliminary, systematic case study sought to determine the impact of RECALL on the correct, spontaneous responding of a young child with autism when implemented by a parent at home. The data indicate that RECALL impacted Jayden’s correct responding to fact, inference, and open-ended questions. Gains were maintained at follow-up, and pre-test scores began escalating in the 4th week suggesting that Jayden increased his ability to answer questions over time. This study is consistent with previous shared reading studies that have shown increased participation/

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<tr>
<th>Phase</th>
<th>Fact</th>
<th>Inference</th>
<th>Open</th>
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<tr>
<td>Pre-baseline</td>
<td>24%</td>
<td>17%</td>
<td>22%</td>
</tr>
<tr>
<td>Pre-tests</td>
<td>33%</td>
<td>17%</td>
<td>39%</td>
</tr>
<tr>
<td>Post-tests</td>
<td>72%</td>
<td>33%</td>
<td>67%</td>
</tr>
<tr>
<td>Maintenance</td>
<td>74%</td>
<td>56%</td>
<td>67%</td>
</tr>
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engagement in shared reading (Bellon, Ogletree, & Harn, 2000; Fleury, Herriott Miramontez, Hudson, & Schwartz, 2014; Whalon et al., 2015). Jayden achieved greater gains when responding to fact-based and open-ended questions than when responding to inference-based questions. This study also adds to the initial study documenting the benefits of RECALL when implemented in preschool settings (Whalon et al., 2015).

Many learners with ASD have trouble understanding the mental states of others, which can limit their ability to identify the thoughts, feelings, and motivations of others in text (Bauminger-Zviely, 2014). To have a greater impact on the inference-making skills of young children with ASD, it may be that more time/opportunities to make inferences, and/or explicit instruction on inference making is required. However, in maintenance, Jayden increased his ability to correctly answer fact-based and inference-based questions and maintained his ability to correctly answer open-ended questions. In an interview following intervention, Jessica admitted to continue to read with Jayden emphasizing emotion questions.

Data also suggest that after minimal training and ongoing feedback, a caregiver was able to implement RECALL as intended. In fact, the participating parent indicated comfort with her implementation of RECALL and enjoyment of the intervention in general. Social validity data also were positive as Jessica acknowledged changes in her reading behavior as well as Jayden’s spontaneous language use. In addition, Jessica reported that both she and Jayden enjoyed RECALL.

This is a preliminary study and, without any replications across participants, the findings must be interpreted with caution as it is impossible to determine whether or not a similar effect would occur with other caregivers and their children with ASD. Future research is needed to determine to what extent caregivers can effectively implement shared reading interventions with their children with ASD at home. Moreover, because the impact of shared reading on the language and emergent literacy skills of young children with ASD remains an understudied topic, additional studies are needed to determine the extent to which children with ASD can benefit from such interventions and what adaptations are needed for children with ASD and varying levels of skill development. Future research should investigate the impact of RECALL when delivered by teachers or paraprofessionals in preschool settings.

Because children with ASD are at-risk for future reading problems, early intensive literacy instruction, with an emphasis on language and comprehension, is necessary (Kaiser et al., 2011). Shared reading is one intervention that targets the oral language skills linked to future reading comprehension (NELP, 2009). This preliminary case study suggests that RECALL may be a user-friendly way to support parent implementation of a shared reading intervention.

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Education and Training in Autism and Developmental Disabilities

Editorial Policy

Education and Training in Autism and Developmental Disabilities focuses on the education and welfare of persons with autism and developmental disabilities. ETADD invites research and expository manuscripts and critical review of the literature. Major emphasis is on identification and assessment, educational programming, characteristics, training of instructional personnel, habilitation, prevention, community understanding and provisions, and legislation.

Each manuscript is evaluated anonymously by three reviewers. Criteria for acceptance include the following: relevance, reader interest, quality, applicability, contribution to the field, and economy and smoothness of expression. The review process requires two to four months.

Viewpoints expressed are those of the authors and do not necessarily conform to positions of the editors or of the officers of the Division.

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1. Manuscript submission is a representation that the manuscript is the author’s own work, has not been published, and is not currently under consideration for publication elsewhere.
3. Each manuscript must have a cover sheet giving the names and affiliations of all authors and the address of the principal author.
4. Research studies, including experimental (group and single-subject methodologies), quasi-experimental, surveys, and qualitative designs should be no more than 20–30 typewritten, double-spaced pages, including references, tables, figures, and an abstract.
5. Graphs and figures should be originals or sharp, high quality photographic prints suitable, if necessary, for a 50% reduction in size.
6. Three copies of the manuscript along with a transmittal letter should be sent to the Editor: Stanley H. Zucker, Mary Lou Fulton Teachers College, Box 871811, Arizona State University, Tempe, AZ 85287-1811.
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10. Please describe subjects (or any other references to persons with disabilities) with a people first orientation. Also, use the term "intellectual disability" (singular) to replace any previous term used to describe the population of students with significant limitations in intellectual functioning and adaptive behavior as manifested in the developmental period.
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