



Review

A review of school-based instructional interventions for students with autism spectrum disorders

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Abstract

This review evaluates school-based instructional research for students with autism spectrum disorders (ASD). Electronic database searches identified 45 studies ($n = 118$ participants) published between 1995 and 2005. These studies were classified into five curricular areas: (a) academic skills, (b) communication skills, (c) functional life skills, (d) play, and (e) social skills. The results of the reviewed studies indicated effective instructional methods and several trends across curricular areas. Fewer than half of the studies ($n = 20$) assessed the generalization of skills to different settings and stimuli. A minority of the studies ($n = 19$) assessed the maintenance of skills. Very few studies reported student characteristics, such as cultural background. Additionally, many studies did not address the social validity of instructional interventions or have used inadequate procedures to judge the perceptions of stakeholders. In light of these findings, several relevant areas for future research are proposed.

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1. Introduction

The core symptoms of ASD include social impairment, communication impairment, and restricted repertoires of behaviors and interests (American Psychiatric Association, 2000, *Diagnostic and Statistical Manual of Mental Disorders*). Students with ASD may be unable to communicate their needs in an appropriate way, lack developmentally appropriate play with toys and peers (Terpstra, Higgins, & Pierce, 2002), have difficulty interpreting nonverbal signals from others (Ozonoff & Miller, 1996), and may engage in disruptive behavior (Machalicek, O'Reilly, Beretvas, Sigafos, & Lancioni, 2007). Without appropriate intervention, deficits in the areas of appropriate classroom behavior, basic functional communication skills, and in navigating common social situations can limit a student's educational progress (National Research Council, 2001). The most effective intervention for ASD continues to be early and intensive education to address these core symptoms (National Research Council, 2001). Accordingly, social, communication, play, life, and academic skills are deemed to be essential targets for instruction with these students (National Research Council, 2001).

The Individuals with Disabilities Education Act (IDEA, 1990, 1997, 2004) provides funding for states to provide students with disabilities, ages 3–21 years, a free and appropriate public education (FAPE). In addition, The No Child Left Behind Act of 2001 (P.L. 107–110, Section 1001) requires teachers to show yearly progress for students with disabilities and encourages teachers to implement evidence-based practices for students with ASD (Browder & Cooper-Duffy, 2003). While this legislation has clear implications for classrooms, special education teachers do not always find the implementation of research-based practices feasible or desirable (Boardman, Argüelles, Vaughn, Hughes, & Klinger, 2005; Cambell & Halbert, 2002; Klinger, Ahwee, Pilonieta, & Menendez, 2003; Snell, 2003; Stanovich & Stanovich, 1997). Teachers themselves have reported feeling ill-prepared or without the proper resources to implement evidence-based practices (Ayres et al., 1994). A review of the instruction research carried out in classroom settings may assist in identifying promising interventions that teachers can use to teach social, communication, play, life, and academic skills to this population. A review of the instruction research may also help in identifying student characteristics (e.g., severity of disability, cultural and linguistic background) that contribute to successful instructional

outcomes for students with ASD. Recent literature reviews have reported interventions for children with ASD (Matson, Benavidez, Stabinsky Compton, Paclawskyj, & Baglio, 1996; McConnell, 2002; Milagros Santos & Lignugaris/Kraft, 1997; Weiss & Harris, 2001), but no known review has focused on school-based instructional intervention research.

The present paper was aimed at providing a comprehensive review of school-based instructional intervention research for students with ASD, ages 3–21 years.

2. Method

Studies were included in this review based on five criteria. Each study: (a) included participants ages 3–21 years with a diagnosis of an ASD; (b) utilized a single subject design; (c) was published in a peer reviewed journal between 1995 and 2005; (d) applied an intervention in an effort to teach skills; and (e) took place within the context of a school. Studies in which the intervention was conducted in another setting (e.g., the home or community) with generalization assessed in a school setting were not included. Studies that did not include three or more data points for each baseline and treatment phase were excluded from this review. Electronic searches were completed using ERIC, PschINFO, and MEDLINE. Searches were carried out using terms such as; “autism” and “instruction”, “play”, “functional skills”, “academic”, “communication” and “social”. Approximately 438 articles were retrieved from this database search. The abstracts of these articles were read to ascertain which studies addressed topics of instruction. Those studies addressing instruction were examined in greater detail to identify whether they met the aforementioned inclusion criteria. The reference sections of those studies were also checked to identify additional studies. A total of 45 studies ($n = 118$ participants) were identified that met the inclusion criteria.

The studies were classified into five categories according to the curricular area that they concerned. The five curricular areas were (a) academic skills, (b) communication skills, (c) functional life skills, (d) play, and (e) social skills. A study was classified as teaching academic skills if the intervention targeted a student’s abilities in reading, writing, science, spelling, or mathematics. Studies were classified as communication interventions if the aim was to develop speech or some alternative form of communication (e.g., manual sign, picture-exchange). One study in this category used both a communication skills intervention and a social skills intervention to increase peer interaction (Kravits, Kamps, Kemmerer, & Potucek, 2002). This study appears in both the communication and social skills category. The functional life skills category included studies that focused on such skills as self-care, domestic, and vocational skills. We classified a study as a play intervention if the intervention focused on appropriate toy use, or involved teaching cooperative or parallel play with peers. Studies were classified as social skills if they taught such behaviors as asking questions, cooperation, initiating or maintaining a conversation, giving or receiving compliments, and greeting others. Prerequisite social behaviors such as perspective taking were also included in the social skills category.

For each evaluated study, Table 1 describes the following seven variables: (a) the number of participants with ASD included in the study, as well as their ages and diagnoses; (b) the presence or absence of generalization and maintenance assessment; (c) the type of intervention, and (d) the findings of the intervention as reported by the authors. The findings are described as positive, negative, or mixed. Positive meant that all of the participants experienced some gain in knowledge or ability from baseline levels during intervention. Mixed meant that, although one or more participants experienced some gain in knowledge or ability, one or more participants did

Table 1

Studies listed according to curricular categories with number (*n*) and age or age range of participants (given in years unless otherwise indicated), diagnosis of participant(s), information regarding generalization and maintenance of skills, type of intervention, and findings

Studies	<i>n</i>	Age	Diagnosis	Generalization/ maintenance	Intervention	Findings
(a) Academic skills						
Akmanoglu and Batu (2004)	2	12,17	Autism and MR ^a	Yes/Yes	Simultaneous prompting to teach pointing to numerals	Positive
Coleman-Martin et al. (2005)	1	12	Mod. ^b autism	No/No	Nonverbal reading approach method with computer assistance to teach word ID ^c	Positive
Ferguson et al. (2005)	1	14	Asperger syndrome	No/No	Used a PDA ^d to increase independent completion of assignments	Positive
Graff and Green (2004)	2	9,12	Autism and profound MR ^a ; autism	No/No	Errorless learning to teach visual discrimination	Mixed
Polychronis et al. (2004)	2	11,7	Mild-mod. ^b autism	Yes/No	Compared distribution of instructional trials across 120 min vs. 30 min to teach telling time and geography	Positive
Riesen et al. (2003)	1	13	Autism	Yes/No	Compared constant time delay to simultaneous prompting in embedded instruction to teach definitions of science terms	Positive
(b) Communication skills						
Buffington et al. (1998)	4	4–6	Autism	Yes/No	Constant time delay + error correction to teach combined gestural and verbal responses	Positive
Dyches (1999)	2	11,10	Autism and sev. ID ^c	No/No	Least-to-most prompting + constant time delay between prompts to teach activation of VOCA ^f to access a beverage	Positive
Hetzroni and Shalem (2005)	6	10–13	Autism and mod. MR ^a	Yes/Yes	Computer program incorporating fading to teach ID ^c of orthographic symbols	Positive
Hetzroni and Tannous (2004)	5	7–12	Autism	No/No	Computer based instruction to reduce echolalia and irrelevant speech	Positive
Johnson et al. (2004)	1	8	Autism	No/Yes	Embedded naturalistic instruction to teach use of VOCA ^f	Positive

Keen et al. (2001)	4	3–7 ^f	Autism	No/No	Naturalistic instruction to teach gestural communication response to replace pre-linguistic communication	Mixed
Kravits et al. (2002)	1	6	Autism	No/No	One-on-one instruction + naturalistic instruction to teach use of PECS ^g	Positive
Schepis et al. (1998)	4	3–5	Sev. ^h autism	No/No	Naturalistic instruction + least-to-most prompting to teach VOCA ^f use	Positive
Sigafoos et al. (2004)	2	12,16	Autism and PDD ^l	No/No	Least-to-most prompting to teach students to retrieve VOCA ^f when not within reach	Positive
Smith and Camarata (1999)	3	4–6 ^f	Mild-sev. ^h autism	No/No	Naturalistic language teaching to improve intelligibility and spontaneous language	Positive
Tincani (2004)	2	5,6	Autism w/MR ^a ; PDD-(NOS) ⁱ	Yes/No	Compared effectiveness of PECS ^g taught with most-to-least prompting and error correction to sign language taught with least-to-most prompting and progressive time delay in the acquisition of mands and vocalizations	Positive
(c) Functional life skills						
Bock (1999)	5	6–10 ^f	Mild-sev. ^h autism	Yes/Yes	Categorization strategy training to teach uni-, bi-, tri-dimensional laundry sorting	Positive
Cicero and Pfadt (2002)	3	4–6 ^f	Autism	Yes/Yes	Package of positive reinforcement + graduated guidance + scheduled practice + forward prompting to toilet train	Positive
Copeland and Hughes (2000)	1	15	Autism and MR ^a	No/No	Self-management program of picture prompts to complete vocational tasks	Positive
Hagiwara and Smith Myles (1999)	2	7,7	Autism	No/No	Multimedia social story to teach hand washing	Mixed
LeBlanc et al. (2005)	3	4	Autism	No/Yes	Modified Azrin and Foxx (1971) procedure to teach toileting	Positive
Taylor et al. (2004)	3	13–17	Autism	Yes/No	Vibrating pager to prompt students to seek assistance when physically separated from adults	Positive
(d) Play						
Baker et al. (1998)	3	5–8	Autism	Yes/Yes	Verbal prompting to teach initiation of socially appropriate playground games based on obsession	Positive

Table 1 (Continued)

Studies	<i>n</i>	Age	Diagnosis	Generalization/ maintenance	Intervention	Findings
Barry and Burlew (2004)	2	7,8	Sev. ^h autism	No/No	Social story to increase choice making, play with toys and peers	Positive
Bevill et al. (2001)	1	5	Autism	No/No	Picture cues + correspondence training to increase engagement with toys	Positive
Boutot et al. (2005)	1	4	Autism	No/No	Compared effectiveness of DTT ^j and naturalistic/milieu instruction to teach play skills	Mixed
D'Ateno, Mangiapanello, & Taylor (2003)	1	3	Autism	Yes/No	Video modeling to teach pretend play	Positive
Kohler et al. (2001)	4	4	Autism;autism + PDD ⁱ ; PDD ⁱ ; autism + PDD ⁱ	No/Yes	Naturalistic teaching strategies to increase social interactions between peers with autism and typically developing peers	Positive
Krantz and McClannahan (1998)	3	4–5	Autism	Yes/No	Script fading to teach students to gain attention of peers during play	Positive
Loncola and Craig-Unkefer (2005)	6	5–8 ^f	Mild-mod. ^b autism	No/No	Cognitive-social model to teach thematic play with peers	Positive
MacDonald et al. (2005)	2	4,7	PDD ⁱ	Yes/Yes	Video-modeling to teach pretend play	Positive
Morrison et al. (2002)	4	42–70 ^k	Autism	Yes/No	Photographic activity schedules and correspondence training to teach selection and subsequent engagement in play activity	Positive
Shabani et al. (2002)	2	6,7	Autism	No/Yes	Vibrating pager as prompt to increase social initiations and responses to peers during free play	Positive
(e) Social skills						
Agran et al. (2002)	1	14	Autism	No/Yes	Self-regulated problem solving to increase appropriate touching	Positive
Akmanoglu-Uludag and Batu (2005)	2	5	Autism	Yes/Yes	Simultaneous prompting to teach names of relatives	Positive
Apple et al. (2005)	2	5	Autism	Yes/Yes	Video modeling w/embedded rules to teach compliment giving	Mixed
Charlop-Christy and Daneshvar (2003)	3	6–9	Autism	Yes/Yes	Video modeling to teach perspective taking skills	Positive

Garfinkle and Schwartz (2002)	3	3–5	Autism	Yes/Yes	Small group instruction with peer leader + least-to-most prompting to teach peer motor imitation	Positive
Kravits et al. (2002)	1	6	Autism	No/No	One-on-one instruction + naturalistic instruction to teach use of PECS ^g	Positive
Laushey and Heflin (2000)	2	5	Sev. ^h autism; PDD-(NOS) ⁱ	No/Yes	Compared peer-initiated procedure to peer proximity alone to teach various social skills	Positive
Newman et al. (2000)	2	6,6	Autism	No/Yes	Self-management of token system to increase variance of responding in social responses	Positive
Sarokoff et al. (2001)	2	8,9	Autism	Yes/Yes	Embedded scripts on packaged stimuli + script fading to teach scripted conversation	Positive
Simpson et al. (2004)	4	5–6	Autism	No/No	Combined video + computer instruction with embedded examples and non-examples to teach following directions, greeting others, and sharing	Positive
Taylor and Harris (1995)	3	5–9	Autism	Yes/No	Progressive time delay to teach “what’s that” when presented with novel stimuli	Positive
Thiemann and Goldstein (2004)	5	6–9	Mild-sev. ^h autism and Asperger syndrome	No/Yes	I. Judged effects of training peers + written text cues on social behaviors. II. Direct instruction via written instruction	Positive

^a Mental retardation.
^b Moderate.
^c Identification.
^d Personal digital assistant.
^e Severe intellectual disability.
^f Voice output communication aid.
^g Picture Exchange Communication System.
^h Severe.
ⁱ Pervasive Developmental Disorder; Pervasive Developmental Disorder-Not Otherwise Specified.
^j Discrete trial training.
^k Age range given in months.

not. Negative findings meant that no participants in the study benefited from the intervention or that one participant gained in one skill and not in another. No study reported negative findings.

The remainder of this paper is organized into the three sections of (a) results, (b) discussion, and (c) future research. The results section presents an overview of treatment outcomes of the research studies according to curricular area. Within each curricular area, two studies are described in detail to illustrate the instructional procedures that typify that particular curricular area. All studies are summarized in Table 1 so that the reader can refer back to them as needed. The Section 4 evaluates the outcomes of the 45 studies ($n = 119$ participants) in regard to the: (a) effectiveness of the interventions, (b) assessment of generalization and maintenance, (c) participant characteristics reported in the literature, and (d) social validity measures reported in the literature. The final section (i.e., future research) offers suggestions for future research.

3. Results

3.1. Overview of studies

3.1.1. Academic skills

Six studies evaluated the effectiveness of instructional interventions to teach academic skills to students with ASD (Akmanoglu & Batu, 2004; Coleman-Martin, Wolff Heller, Cihak, & Irvine, 2005; Ferguson, Smith Myles, & Hagiwara, 2005; Graff & Green, 2004; Polychronis, McDonnell, Johnson, Riesen, & Jameson, 2004; Riesen, McDonnell, Johnson, Polychronis, & Jameson, 2003). Coleman-Martin et al. (2005) examined the use of the Nonverbal Reading Approach (NRA) to teach students such skills as word identification. Riesen et al. (2003) compared constant time delay to simultaneous prompting to teach science vocabulary definitions.

Coleman-Martin et al. (2005) evaluated the NRA across three conditions (teacher instruction only, teacher instruction and computer-aided instruction, and computer-aided instruction only) to teach word identification (e.g., such words as shock, brave, slept) to a 12-year-old student. The student was enrolled in a classroom for students with moderate disabilities and he used both gestures and an AAC device to communicate. The NRA instruction involved a metacognitive strategy of saying words to oneself following a verbal model and teacher and/or computer-aided instruction to walk the student through the process. In the teacher instruction condition, the teacher provided verbal prompts (“... in your head, say this sound, mmm.”). Computer-aided instruction consisted of a sequence of instructional slides that told the student how to say the words in their head (“... in your head say this sound, mmmm.”) with a final slide presumed to be reinforcing (a colorful picture with a written praise statement). The teacher instruction plus computer aided instruction consisted of the teacher providing the prompts for the metacognitive strategy prior to computer instruction. The student performed equally well across all conditions, reaching a criterion of 80% of target words correctly produced over two consecutive sessions, but required fewer teaching sessions during computer-aided instruction.

Riesen et al. (2003) examined the effectiveness of constant time delay versus simultaneous prompting to teach science vocabulary words to a 13-year-old student. The student was taught to verbally define (respond correctly to) 10 science vocabulary words (e.g., fossil, convection, continent) during a general education class. Five vocabulary words were taught using constant time delay and the remaining using simultaneous prompting. All instruction was implemented by a paraprofessional. Each instructional condition (constant time delay versus simultaneous prompting) was alternated across school days. During the simultaneous prompting condition, the student was first provided with an initial prompt (“It is time to define your words”). Second, the

student was presented with a flash card of the printed word and definition. Third, the paraprofessional verbally modeled the correct response for him (“The word is fossil. The definition of fossil is an organism that has been preserved in rock”). The student was praised for correct responses. An error correction procedure (the paraprofessional stated “no” and repeated the model) was implemented following wrong answers. Each vocabulary word that was not defined correctly was presented at least three times during a class. During the constant time delay procedure, the student was again provided with an initial prompt (“It is time to define your words”) and the flash card. The verbal model was progressively delayed from 0 to 3 s following the presentation of the flash card. The error correction procedure during time delay instruction was identical to the simultaneous prompting condition. The student reached 100% accuracy during two consecutive testing probes in both conditions. The results indicated that both simultaneous and constant time delay were effective. However, the student required a mean of 34 constant time delay instructional trials compared to a mean of 17 simultaneous prompting instructional trials to reach criterion. This finding indicates that simultaneous prompting may lead to faster memorization of vocabulary words for some students with ASD.

3.1.2. *Communication skills*

Eleven studies addressed the communication skills of students with ASD (Buffington, Krantz, McClannahan, & Poulson, 1998; Dyches, 1999; Hetzroni & Shalem, 2005; Hetzroni & Tannous, 2004; Johnson, McDonnell, Holzwarth, & Hunter, 2004; Keen, Sigafos, & Woodyatt, 2001; Kravits et al., 2002; Schepis, Reid, Behrman, & Sutton, 1998; Sigafos, O’Reilly, Seely-York, & Edrisinha, 2004; Smith & Camarata, 1999; Tincani, 2004). Many studies in this category used one or more common instructional procedures such as time delay to teach gesture and verbal responses (see Buffington et al., 1998). Other studies taught students to use a voice output communication aid (VOCA) (see Schepis et al., 1998).

Buffington et al. (1998) taught four students, ages 4–6 years, to use gestures in combination with speech. Prior to intervention, all of the students used some speech, but none used gestures appropriately. Students were taught three categories of combined gesture and vocal responses to stimuli. These response categories were attention-directing or getting responses (pointing and saying, “look”), affective responses (shaking head and saying, “No way”), and reference responses (making a gesture to indicate something was tiny and saying, “It’s tiny”). Instruction was conducted in an empty classroom, but generalization was assessed among peers in the student’s typical classroom and to novel stimuli. The experimenter first modeled the correct gestural and verbal response, waited 5 s., and then provided the student with additional modeling and verbal prompts as needed to elicit imitation. Each of the four students learned to appropriately use gestures combined with speech across all three response categories. Additionally, each of the students demonstrated generalization to their classroom and to novel stimuli.

Schepis et al. (1998) evaluated the effectiveness of a VOCA and naturalistic teaching on the communication skills of four students, ages 3–5 years, in a special education classroom. The VOCA’s that were used in this study were selected based on student characteristics, but each VOCA was a battery operated device with four or more buttons that played an audible voice recording (e.g., “I’m finished”) when a student applied pressure to individual buttons. Each button played a separate message and included a picture symbol and printed word of the message that would play upon activation of that particular button. In addition, each button was color coded according to the grammatical category of the printed word. The number of messages varied according to the student and ranged from 4 to 8 distinct messages. Prior to

intervention, teachers participated in a brief training on the use of the VOCA and naturalistic teaching methods they could use to teach VOCA use. During intervention, the teacher utilized graduated guidance and naturalistic teaching strategies (e.g., following the lead of the child, using preferred stimuli available during the natural routine) to teach the student to use the VOCA across snack for all four students and a play routine for two of the students. For instance, if during snack a child reached his hand towards a food item, the teacher looked expectantly at the student and gestured towards the VOCA. The teacher might say, “Do you want more?”. If the student did not activate the VOCA, the teacher prompted the student using as little physical prompting as needed to activate the appropriate message. Each of the student’s communicative interactions increased during intervention across all the settings they received instruction. However, for three of the students, no child-to-child communication was observed and only seven such exchanges were observed for the remaining student. It is of interest that there was no observed decrease in the frequency of non-VOCA communication that was present during baseline assessment.

3.1.3. *Functional life skills*

Six studies examined strategies to teach students with ASD functional living skills (Bock, 1999; Cicero & Pfadt, 2002; Copeland & Hughes, 2000; Hagiwara & Smith-Myles, 1999; LeBlanc, Carr, Crossett, Bennett, & Detweiler, 2005; Taylor, Hughes, Richard, Hoch, & Coello, 2004). These studies evaluated instruction methods such as categorization training to teach students to sort laundry (Bock, 1999), and vocational tasks (Copeland & Hughes, 2000). One study used a multimedia Social StoryTM to teach hand washing (Hagiwara & Smith Myles, 1999). Self-management strategies such as picture and tactile prompts were used to teach vocational tasks (Copeland & Hughes, 2000) and community safety skills (Taylor et al., 2004). In addition, studies also have evaluated reinforcement procedures to toilet train students with ASD (Cicero & Pfadt, 2002; LeBlanc et al., 2005).

Cicero and Pfadt (2002) examined the effectiveness of a reinforcement-based toilet training package for three students, aged 4–6 years. Prior to intervention the students wore diapers and had daily urination accidents. The procedure consisted of reinforcing urination in the toilet, graduated guidance, scheduled practice trials, and forward chaining. Prior to intervention, teachers received training via readings, instruction, role-play and *in vivo* practice. In addition, a preference assessment was also conducted for each student to identify possible stimuli of reinforcing value. During the intervention, several procedures were in place: (a) the student and teacher spent the entire day within the school bathroom; (b) students wore minimal clothing (i.e., underwear, undershirt, and socks) so that teachers could quickly detect a urination accident; (c) the student was encouraged to drink as many liquids as desired; and (d) the student was prompted using graduated guidance to request to use the toilet every 30 min. The student was reinforced for urinating on the toilet within 3 min of sitting down. If the student was not sitting on the toilet and began to urinate, the teacher first attempted to startle the student (“No, no, no, pee on toilet!”). Then the student was prompted to move to the toilet. If urination subsequently occurred in the toilet, reinforcement was provided. Once the student began to spontaneously request to use the toilet and urinated while on the toilet, the prompting schedule was discontinued. The other aspects of training (e.g., increased liquid intake, bathroom time) were quickly faded once the student was spontaneously requesting and not having accidents. The reinforcement and prompting procedure effectively reduced urination accidents to zero for all three students within 7–11 days of the intervention. Additionally, these results were maintained at 6-month and 1-year follow-up assessments.

Taylor et al. (2004) taught students, ages 12, 14, and 17 years, to seek assistance when in community settings and separated from an adult. This study utilized a vibrating pager to prompt the student to seek assistance. During the acquisition phase of the study, the students role-played in their school building. The students were given a vibrating pager and communication card that contained the student's name, a statement that they were lost, and an instruction to contact a parent or teacher. The students also received verbal instructions regarding the required response. Initially, the teacher stood 1 ft away from the student and activated the pager, which vibrated for 2 s. Following the pager activation, the teacher guided the student to the nearest adult, modeled the verbal response ("Excuse me"), and prompted the student to hand the adult their communication card. When the student performed the correct response, he or she was praised and given a preferred food item. The use of prompts and tangibles was successfully faded and each student reached a criterion of 100% independent responding over three consecutive trials. Once the student had reached criterion in the school setting, teaching and the assessment of generalization in five community sites began. Instructional trials in the community included a 30 s constant time delay following activation of the pager, and a least-to-most prompting hierarchy. During generalization assessment, the teacher was out of sight when she activated the pager. Each student correctly responded in the community.

3.1.4. *Play*

Eleven studies taught students with ASD to play appropriately with toys and/or peers (Baker, Koegal, & Koegal, 1998; Barry & Burlew, 2004; Bevill, Gast, Maguire, & Vail, 2001; Boutot, Guenther, & Crozier, 2005; D'Ateno, Mangiapanello, & Taylor, 2004; Kohler, Anthony, Steighner, & Hoyson, 2001; Krantz & McClannahan, 1998; Loncola & Craig-Unkefer, 2005; MacDonald, Clark, Garrigan, & Vangala, 2005; Morrison, Sainato, Benchaaban, & Endo, 2002; Shabani et al., 2002). Some studies used technology such as video modeling to teach pretend play (see MacDonald et al., 2005). Other studies utilized self-management strategies such as picture cues or activity schedules to increase engagement in play (see Bevill et al., 2001).

Bevill et al. (2001) evaluated the effects of a hierarchical intervention consisting of picture cues and correspondence training on the engagement of a 5-year-old student during free play. The student spent most of his day in a special education classroom, but visited an inclusive preschool setting during free play. Prior to intervention the student typically chose to play alone with the same play activity each day during his time in the inclusive setting. The hierarchical intervention involved four sequential conditions. First, the experimenter showed the student photographs of all the available play activities and had him plan three activities that he would participate in during the free play session. To plan activities, the student attached the photographs onto a planning board. The experimenter provided specific feedback about the student's chosen activities ("You said you'd play cars, computer, and art. You may go and play now"). Second, the student prepared to play in the same manner as before, but tangible reinforcement was provided for attaching the photographs onto the planning board. Third, the experimenter told the student he could look at his planning board if he forgot his planned activities. During the final condition, the student was reinforced with preferred tangibles when the experimenter observed him participating in his planned activities. At the end of the free play session, the student and experimenter reviewed the planned activities and if the student had participated in each of the three planned activities, he received reinforcement. If the student had failed to participate in one or more activities, he received specific feedback about the plan ("... You said you would play with the computer, but you didn't. You need to follow your plan to get a sticker ..."). Following intervention, the

student's engagement in planned play activities increased and maintained with partial removal of the intervention.

MacDonald et al. (2005) taught two students, ages 4 and 7 years, to engage in thematic pretend play using video-modeling. Instruction was carried out in an area within each student's special education classroom and play sessions were carried out in a separate area of the classroom. The students were shown a short video of an adult engaging in scripted pretend play with the objects and figurines of a thematic play set (e.g., ship, town, and house). Then the students were given 4 min to independently interact with the play set that was shown in the video. The video was shown prior to play sessions until the student reached a criterion of 80% accuracy on all scripted actions and verbalizations. Both students demonstrated an increase in scripted play across a total of three play sets. Furthermore, the student's scripted play maintained following withdrawal of the video. However, the students did not demonstrate unscripted play. In fact, one student's unscripted play decreased during intervention.

3.1.5. *Social skills*

Twelve studies examined strategies for teaching students with ASD a variety of social skills (Agran, Blanchard, Wehmeyer, & Hughes, 2002; Akmanoglu-Uludag & Batu, 2005; Apple, Billingsley, Schwartz, 2005; Charlop-Christy & Daneshvar, 2003; Garfinkle & Schwartz, 2002; Kravits et al., 2002; Laushey & Heflin, 2000; Newman, Reinecke, & Meinberg, 2000; Sarokoff, Taylor, & Poulson, 2001; Simpson, Langone, Ayres, 2004; Taylor & Harris, 1995; Thiemann & Goldstein, 2004). Studies in this category used common instructional procedures such as response prompts to teach students the names of family members (Akmanoglu-Uludag & Batu, 2005). Another study used embedded scripts on packaged items to teach conversation scripts (Sarokoff et al., 2001). Some studies used video modeling to teach compliment giving (Apple et al., 2005), perspective taking (Charlop-Christy & Daneshvar, 2003), and video modeling combined with computer instruction to teach following directions, greeting, and sharing (Simpson et al., 2004). Other studies used such self-management strategies as problem solving to teach appropriate touch (Agran et al., 2002), and a token system to increase varied social responses (Newman et al., 2000). Kravits et al. (2002) examined the use of naturalistic instruction to increase a student's peer interaction. In addition, some studies have included peers as part of the intervention (Garfinkle & Schwartz, 2002; Laushey & Heflin, 2000; Thiemann & Goldstein, 2004).

Garfinkle and Schwartz (2002) evaluated the effectiveness of a peer imitation intervention for three students, ages 3, 4 and 5 years, at an inclusive preschool. Prior to intervention, each of the students demonstrated imitation of adult gestures and motor behavior, but none of the students imitated same-age peers. The intervention consisted of four steps: (a) the teacher provided instructions to the participants including typically developing students ("... When you are a leader you can _____. When you're not the leader you can do what the leader is doing"), (b) the teacher selected one of the students to be the leader, (c) the teacher used a least-to-most prompting hierarchy to prompt students to imitate the leader, and (d) the teacher verbally praised the students who imitated the actions of the leader. Generalization of imitation to free play sessions was assessed for all three participants and follow-up assessment was conducted for two of the students. Each of the students demonstrated small gains in peer imitation, but no increases in social interactions. One student's gains were maintained only during the first day of follow-up assessment.

Sarokoff et al. (2001) taught two students, ages 8 and 9 years, to converse about specific stimuli using a script fading procedure. Instructional sessions were carried out in a classroom,

treatment room, or an activities room at a private school for children with ASDs. The students were presented with favorite items (SkittlesTM candy) and a separate piece of paper containing a written conversational script. For each conversational script, the name of the item was the first word spoken (“SkittlesTM are my favorite candy”). The script was systematically faded until only the item name remained. Each student received a script that was complimentary to the other student’s script. Generalization was assessed across three other items and to novel students. When a novel item was assessed, rather than written on a separate piece of paper, the script was embedded on the packaged item itself (“SkittlesTM are my favorite candy” was written on the outer covering of the packaged candy). The scripts were successfully faded across all three items and both students increased their frequency of both scripted and unscripted statements across all three items. Maintenance assessment at 1 month following intervention demonstrated that the students continued to engage in scripted statements when instructions were not given and when adults were not present.

4. Discussion

4.1. Effectiveness of the interventions

The majority (91%) of studies reported positive findings. In the six studies addressing academic skills, positive changes were reported for 7 of the 9 participants (78%). In the 11 studies addressing communication skills, positive changes were reported for 33 of the 34 participants (97%). In the six studies addressing functional life skills, positive changes were reported for 15 of the 17 participants (88%). In the 11 studies addressing play, positive changes were reported for 28 of the 29 participants (97%). Finally, in the 12 studies addressing social skills, positive changes were reported for 32 of the 33 participants (97%). As previously mentioned, one study in the social skills category used both a communication skills intervention and a social skills intervention to increase peer interaction and is also listed in both of these categories (Kravits et al., 2002).

Some studies reported mixed findings for one or more participants (Apple et al., 2005; Boutot et al., 2005; Graff & Green, 2004; Hagiwara & Smith Myles, 1999; Keen et al., 2001; Simpson et al., 2004). Two of these studies reported mixed results that could be attributed to the study’s goal, which was to compare the effectiveness of two interventions (Boutot et al., 2005; Graff & Green, 2004). For example, in a comparison of discrete trial training (DTT) and naturalistic instruction to teach play skills, Boutot et al. (2005) found that naturalistic instruction led to more correct responses than DTT. Similarly, Graff and Green (2004) compared progressive time delay to a stimulus control shaping procedure. They found that the shaping procedure was superior to progressive time delay for teaching visual discrimination. Other researchers reported mixed findings due to a combination of participant and intervention variables (Apple et al., 2005; Hagiwara & Smith Myles, 1999; Keen et al., 2001; Simpson et al., 2004). For instance, Hagiwara and Smith Myles (1999) reported mixed findings due to one student responding to intervention at a lower rate than other participants.

In light of these findings, a couple of points can be made. First, each of the curricular categories has high percentages of success (range 78–97%) and would therefore seem to indicate effective interventions to teach students with ASD. Nevertheless, we are unable to draw strong conclusions regarding the comparative effectiveness of these interventions, because of the variability between studies, such as, the targeted skill(s), participant characteristics, instructional procedures, and the magnitude of behavioral change during intervention. Second, it is important

to note that some studies reported positive results when the data indicate less than impressive intervention effects. Such outcomes suggest the difficulty of teaching skills to students with ASD and the continued need to examine instructional strategies.

4.2. Assessment of generalization and maintenance

Fewer than half of the studies ($n = 20$ studies) assessed for generalization of skills to other settings, stimuli, persons, and/or conditions (see [Table 1](#)). The results of generalization assessment in these studies are mixed. The majority of these studies (89%) have reported findings that indicate the generalization of target behaviors to untrained settings, stimuli, persons, and/or conditions. For instance, [Taylor and Harris \(1995\)](#) assessed the generalization of question asking in different settings, across novel instructional stimuli, and with different therapists and found all three students to demonstrate target skills in each of these conditions. However, the findings of approximately 11% of the studies that report generalization indicate that skills may not spontaneously transfer to new settings, stimuli, persons, and/or conditions without intervention. For example, [Hetzroni and Shalem \(2005\)](#) assessed the generalization of symbol identification and found that two of the six participants demonstrated weak generalization to untrained stimuli. Additionally, 20% of the studies reporting generalization indicated that the results were mixed.

A total of 19 studies reported on maintenance of skills following withdrawal of instruction (see [Table 1](#)). The majority of these studies (79%) have reported positive findings. For instance, [Apple et al. \(2005\)](#) assessed the maintenance of social skills immediately following withdrawal of the intervention and found the students to perform at intervention levels. We would expect that those interventions leading to the maintenance of target skills would generally have stronger, more durable effects than other interventions. However, the findings of approximately 47% of the studies that report maintenance indicate that skills may deteriorate without continued intervention. For example, [Garfinkle and Schwartz \(2002\)](#) assessed the maintenance of imitation behavior and found that only one of several students' showed any maintenance of imitation and that particular student only showed maintenance of imitation skills for a single day. Some 32% of studies reported mixed findings with positive maintenance effects in some contexts, but not in others.

We were unable to conclude which types of interventions lead to better maintenance and generalization of targeted skills, because so few studies evaluated the maintenance and/or generalization of skills. Also, the variability in the different target behaviors, interventions, settings, conditions, and outcomes makes meaningful comparison between studies more difficult. Nonetheless, several points regarding the generalization and maintenance of skills can be made. First, these findings reveal the complexity of developing durable classroom interventions and the importance of assessing the generalization and maintenance of skills taught to students with ASD. Some studies reported increased variability, or a decrease in skills for some participants during maintenance assessment. Likewise, some studies reported a failure of students to generalize skills to new stimuli, settings, and/or conditions. These findings suggest that some students with ASD will require additional interventions or time exposed to interventions to generalize and maintain skills. These findings have important implications for teaching staff including the need to monitor target behaviors during and following intervention to ensure appropriate levels of responding across settings and relevant stimuli. Such long-term monitoring would give teaching staff the opportunity to respond to decreased levels of student responding with additional instruction. Alternatively, increasing a student's fluency of responding prior to withdrawal of the intervention may lead to increased maintenance effects for some students

(Singer-Dudek & Greer, 2005). No intervention reviewed here demonstrated fluency due to planned intervention efforts, but the increased maintenance of skills we saw for some students might be in part attributed to such effects. Increased intervention time in a primary setting might also assist a student in applying skills to new settings and situations. Further examination of the influence of fluency and other variables on the generalization and maintenance of skills is warranted.

Second, natural stimuli and not instructional stimuli, must be incorporated into instruction in order to maximize generalization and maintenance. If natural stimuli are not included, the withdrawal of an intervention effectively places the student's behavior on extinction. This could explain the decreases in target skills demonstrated by some participants immediately following withdrawal of the intervention and the failure of some students to generalize target skills to new settings. Teachers should therefore incorporate strategies that promote generalization such as training in the natural settings and using natural consequences to reinforce new behaviors. Some studies ($n = 13$) implemented interventions in more than one setting, or across behaviors, conditions, or instructional stimuli. Planning for the generalization of target skills may require additional training for the teaching staff and parents who are present in the environments where generalization is desired. Alternatively, the generalization and maintenance of skills might be increased by systematically fading the reinforcement for target responses. This systematic fading of the reinforcement during the intervention might enhance the durability of the response.

4.3. Participant characteristics reported in the literature

Each of the studies included in this review report the age, gender, and diagnosis of participants. Participants ranged from 3 to 17 years, but the majority (53%) of participants were between 3 and 6 years. Five percent of the students were between 14 and 17 years. This finding indicates a focus on evaluating interventions for younger children. The early treatment of children with ASD is of obvious importance, but the evaluation of interventions for older children is also necessary. The content of instruction changes as a child moves into high school and oftentimes there is an increased focus on teaching functional life, self-management, and vocational skills to older students. Additionally, older students may be more concerned than younger ones about the perceptions of peers, which could alter the types of instruction that are socially valid for the student. Without further research involving older students, it would be premature to conclude that those interventions that appear effective for teaching younger children will translate into successful interventions for older children.

The majority (56%) of participants were simply described as having a diagnosis of autism. Some participants (18%) were described as having a diagnosis secondary to their primary diagnosis of autism (e.g., autism and profound mental retardation). Other participants (19%) were described according to the severity of their ASD diagnosis (mild, moderate, severe). Of these participants, more were reported as having mild-moderate autism ($n = 14$ participants) than severe autism ($n = 9$ participants). Only 3% of the participants were reported as having a diagnosis of Asperger's syndrome. Also, only 3% of the participants were described as having a diagnosis of Pervasive Developmental Disorder (PDD) or Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS). The reported severity of a student's disability does not seem to preclude successful outcomes of instruction. Some studies have reported positive findings for participants with severe ASD and others have reported somewhat mixed results for such students. What is clear is that the individualization of instructional interventions contributes in part to successful outcomes for students with severe ASD. Some researchers changed their

instructional protocol to better meet the needs of students who initially had trouble learning the correct response (Krantz & McClannahan, 1998; Thiemann & Goldstein, 2004). For instance, Krantz and McClannahan (1998) reported that their instructional procedure was temporarily changed for the participant with the lowest intelligence quotient, because he initially failed to engage in the targeted behavior. We can conclude from these findings that interventions have been effective for teaching skills to children with a wide range of ASD diagnoses. However, some of the reviewed studies suggest that students with a more severe level of ASD will benefit from additional support during intervention. Given the wide range of abilities of students with ASD, some students may require more or less support in some curricular domains. For instance, some students with severe autism or concomitant intellectual disability may require concentrated instruction in functional life and functional academic skills. Students with Asperger's syndrome may require social skills interventions with less emphasis on functional life skills. Given the limited research focused on the unique needs of students with severe autism, Asperger's syndrome, and PDD/PDD-NOS, it would be premature to suggest that those interventions found to be effective for students with less severe and/or different diagnoses (i.e., mild autism) will be appropriate for these subgroups of students.

The inclusion of cultural and linguistic background information varied among studies irrespective of the curricular area. Indeed, only 10 of 45 studies reported the cultural and/or linguistic background of participants (Akmanoglu-Uludag & Batu, 2005; Bevill et al., 2001; Bock, 1999; Boutot et al., 2005; Ferguson et al., 2005; Hagiwara & Smith Myles, 1999; Hetzroni & Tannous, 2004; Loncola & Craig-Unkefer, 2005; Smith & Camarata, 1999; Tincani, 2004). This absence of ethnicity and/or race information is troubling given that these aforementioned interventions address such culturally mediated skills as communication, social, play, and functional life skills. Students from culturally and linguistically diverse (CLD) backgrounds and their families may perceive intervention procedures in ways that are different than those of the teacher and/or researcher. Indeed, the social acceptability of an intervention might be affected by the experiences of students and their families. For instance, students from CLD backgrounds may perceive and express social interactions differently and targeted skills identified by researchers may not be socially acceptable to the focus student or their family (Ogbu, 1981; Olmeda & Kauffman, 2003).

4.4. Social validity measures reported in the literature

A small number of studies ($n = 16$ studies) used social validity measures such as written questionnaires, video clips, and focus groups to judge the social acceptability of interventions (Agran et al., 2002; Akmanoglu-Uludag & Batu, 2005; Akmanoglu & Batu, 2004; Apple et al., 2005; Buffington et al., 1998; Coleman-Martin et al., 2005; Garfinkle & Schwartz, 2002; Johnson et al., 2004; Laushey & Heflin, 2000; LeBlanc et al., 2005; Morrison et al., 2002; Polychronis et al., 2004; Schepis et al., 1998; Smith & Camarata, 1999; Thiemann & Goldstein, 2004; Tincani, 2004). Other studies reported brief anecdotal comments regarding the satisfaction of families and teachers following the intervention (Baker et al., 1998; Barry & Burlew, 2004; Ferguson et al., 2005). Each of these studies reported positive perceptions of their respective interventions based on the results of social validity assessments. The small number of studies that reported the social validity of their interventions precludes a statement regarding the social validity of specific interventions. We can say that the quality of social validity measures in the reviewed studies is variable and there is room for improvement regarding the type of measurement tool utilized, the frequency of assessment, and the involvement of stakeholders.

A single study utilized an empirically validated social validity questionnaire (LeBlanc et al., 2005). LeBlanc et al. (2005) used the Treatment Evaluation Inventory-Short Form (TEI-SF; Kelly, Heffner, Gresham, & Elliot, 1989). Other researchers either used subjective measures that had not been empirically validated or modified versions of validated social validity questionnaires and checklists (Morrison et al., 2002; Smith & Camarata, 1999). A lack of congruency between response to intervention and social validity results might be attributed to poorly constructed questionnaires. For instance, Apple et al. (2005) asked parents and teachers to rate the participant's social skills, relationships with peers, and experience giving compliments using a 5-point Likert scale. The teachers reported that one participant's social skills had not changed following intervention. However, a visual analysis of this student's data shows an increase in compliment initiations from 0 compliments during baseline assessment to 2 compliments per 15-min observation during the intervention. Although a visual analysis of the student's data shows some improvement, the amount and/or quality of a student's improvement may have failed to meet the teacher's expectations for classroom behavior. These findings suggest that researchers should consider enlisting teaching staff to define the amount of behavioral change required to produce significant improvement.

The majority of studies reviewed here have only assessed the social validity of their intervention following implementation of the intervention. Wolf (1978) suggested envisioning social validity as a tripartite construct that involves the social acceptability of the intervention goals, the acceptability of the intervention procedures, and the acceptability of participant outcomes. Such a thorough assessment might involve pre- and post-intervention assessment in addition to ongoing assessment throughout the study (Wolf, 1978). A few studies offer examples of how researchers might better incorporate social validity assessments during all phases of the study (Apple et al., 2005; Laushey & Heflin, 2000; Schepis et al., 1998; Thiemann & Goldstein, 2004). Intermittent assessment of stakeholders, such as that utilized in Schepis et al. (1998), may facilitate the proactive responding of researchers to the concerns of students, teachers, and families and might prevent attrition. It might also inform researchers about the characteristics of acceptable classroom interventions across all phases of learning (e.g., acquisition, generalization, maintenance).

Few studies ($n = 5$) involved stakeholders beyond teachers or parents in the assessment of social validity (Agran et al., 2002; Coleman-Martin et al., 2005; Laushey & Heflin, 2000; Schepis et al., 1998; Thiemann & Goldstein, 2004). These studies assessed the perceptions of school directors (Schepis et al., 1998), participating students (Agran et al., 2002; Coleman-Martin et al., 2005; Morrison et al., 2002), graduate students (Thiemann & Goldstein, 2004), and classmates (Thiemann & Goldstein, 2004). The perceptions of other stakeholders, such as peers may be vital to the maintenance of interventions.

5. Future research

The Committee on Educational Interventions for Children with Autism described six essential interventions for this population (National Research Council). These six interventions include teaching children functional communication, social, play, academic and cognitive skills, and decreasing challenging behavior (National Research Council). This paper reviewed 45 school-based studies that examined instructional strategies to teach the aforementioned adaptive skills to students with ASD. Positive effects were reported for 94% of participants. Definitive conclusions as to the comparative effectiveness of particular interventions cannot be drawn. However, taken as a whole, these interventions appear to be effective across age, diagnosis, and curricular areas

for students with ASD. Notwithstanding these findings, several issues might be examined by future research.

The generalization and maintenance of skills are important instructional outcomes for students with ASD. Many students with ASD have difficulty transferring skills learned in one setting or situation to untrained settings or situations, and/or have difficulty maintaining skills over time (National Research Council, 2001). The assessment of generalization and maintenance of targeted skills should be included in all future studies that evaluate instructional strategies with this population. For example, research targeting functional living skills (e.g., dressing, toileting) might assess acquisition of such skills in the classroom context, but also probe for generalization to daily living contexts such as the home and other relevant community settings (e.g., toileting at the mall). The assessment of maintenance should probe for the long-term durability of the newly acquired skills once the intervention is withdrawn. In our dressing and toileting examples above the researchers might probe these newly acquired skills in classroom and community settings for up to 6 months following the removal of the intervention. The ultimate applied veracity of an intervention should be determined by its capacity to produce robust generalization and maintenance results.

Related to the above point, it is important that future research on instructional strategies should incorporate techniques to promote generalization and maintenance of skills trained as part of the instructional package. At first glance this proposal may seem cumbersome, especially if studies are primarily designed to examine such questions as rate of acquisition, or the use of new adaptive technology during instruction. We suggest that while the aforementioned questions are very relevant they should still be examined within the context of generalization and maintenance of the skills trained. A variety of empirically validated strategies to promote generalization (e.g., teach sufficient exemplars, teach functional skills) and maintenance (e.g., gradually fade reinforcement contingencies, recruit natural communities of reinforcement) have been reported in the literature (see Stokes & Osnes, 1988 for a review of this literature). Researchers should review these generalization and maintenance strategies as they plan instructional research and incorporate suitable strategies into an instructional package.

Future research should include more detailed description of participant characteristics such as race, family characteristics, and socioeconomic status (Lim, 2001; Meyer, 2001; National Research Council, 2001). An examination of such variables could assist researchers to determine the ways in which such variables affect the outcomes of instructional interventions for students with ASD from CLD backgrounds. Without the inclusion of this information we cannot determine the effectiveness of current interventions for CLD students. Thus, future research should focus on examining the effects of instructional interventions for CLD students, and the acceptability of interventions for their families. To achieve these goals, researchers should actively recruit participants whenever possible from CLD backgrounds, and include a rich description of the student, their family, and their teaching staff. Future research should experimentally evaluate the effect of these participant variables on student outcome. In addition, it is imperative that journals take a leadership role in this agenda by encouraging researchers to include such participant information.

The social validity of an intervention will determine whether teaching staff continue the intervention after data collection ends, and whether the skills will be reinforced and thus generalized to other environments, such as home. The assessment of the social validity of an intervention requires evaluating the social acceptability of the goals, procedures, and outcomes of an intervention (Schwartz & Baer, 1991; Wolf, 1978). Social validity in the reviewed studies has largely been assessed using non-standardized measures. Thus, future research should focus on

evaluating the reliability and validity of both current and novel strategies for assessing the social validity of instructional interventions for students with ASD. This might best be achieved via traditional measurement evaluation techniques (e.g., test–retest, split-half reliability measures) to evaluate the construct validity of the measure. In addition, future research should focus on assessing the social validity of an intervention repeatedly over time, and involve participants, peers and other stakeholders (e.g., family members, general educators). The inclusion of multiple stakeholder perceptions could be achieved through the use of focus groups or questionnaires. Such tools have been used in some of the studies reviewed here, but future research should incorporate multiple measures of social validity to determine instructional goals, strategies, and outcomes for students with ASD.

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