Review

Teaching individuals with autism spectrum disorder to ask questions: A systematic review

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ABSTRACT

This review involved a systematic search and analysis of studies aimed at teaching individuals with autism spectrum disorder (ASD) to ask questions (i.e., teaching mands for information). A systematic search of databases, reference lists, and journals identified 21 studies that met predetermined inclusion criteria. Included studies were then summarized in terms of (a) participant characteristics, (b) dependent variables (e.g., types of question-asking skills that were taught), (c) intervention procedures, (d) research designs, and (e) outcomes. All 21 studies reported that participants acquired or improved in the targeted question-asking skills. The most common intervention components included (a) echoic prompts and systematic fading procedures (e.g., time delay), (b) positive reinforcement via provision of requested information and/or access to preferred items or activities, and (c) contriving situations to motivate specific questions (i.e., creating establishing operations). Implications for practitioners and directions for future research are discussed.

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Contents

1. Methods	867
1.1. Search procedures	867
1.2. Inclusion and exclusion criteria	867
1.3. Data extraction	868
1.4. Reliability and inter-coder agreement	868
2. Results	868
2.1. Participants and intervention settings	868
2.2. Dependent variables	868
2.3. Intervention procedures	875
2.4. Research design	875

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2.5. Outcomes	876
3. Discussion	876
References	877

Typically developing children experience a rapid increase in spoken language between two and three years of age. This is sometimes referred to as a “language explosion” (Brown, 1968; Brown, Cazden, & Bellugi-Klima, 1969; Panico, Daniels, & Claflin, 2011). During this developmental period, specific forms of questions (e.g., what?, where?, and how?) often emerge in a predictable developmental sequence (Bloom, Merkin, & Wooten, 1982; Smith, 1933; Tyack & Ingram, 1977). From a behavioral perspective, questions are defined by their functional properties and question-asking is classified as a type of request (or mand) for information (Skinner, 1957). For example, “Please tell me the time.” and “What time is it?” are both mands for information that are typically reinforced in the natural environment by the provision of the requested information from a communication partner (e.g., “It is 8:48.”).

Learning to ask questions (i.e., to mand for information) is paramount for academic success, social interaction, adaptive functioning (e.g., locating a restroom in an unfamiliar environment), and many forms of employment (Brown, 1968; Brown et al., 1969; Chouinard, 2007; Fahey, 1942; Koegel, Carter, & Koegel, 2003; Lewis, 1938; Light & Binger, 1998; Ostry & Wolfe, 2011a; Secan, Egel, & Tilley, 1989; Skinner, 1957; Smith, 1933; Sundberg & Michael, 2001; Sundberg & Partington, 1998; Tyack & Ingram, 1977). Koegel et al. (2003) pointed out that teaching question-asking might also allow students to access more learning opportunities in less restrictive settings. Unfortunately, many individuals with autism spectrum disorders (ASD) do not seem to readily learn to ask questions, ask too few questions, or ask unusual or inappropriate questions (e.g., Stone, Ousley, Yoder, Hogan, & Hepburn, 1997; Wetherby & Prutting, 1984). Such deficits in question-asking can inhibit academic achievement and social interaction, and more generally reduce the person's overall quality of life.

Given the importance of question-asking skills and the deficits in question-asking that are experienced by some individuals with ASD, it is not surprising that intervention research has focused on improving this aspect of communication. Although many reviews involving communication intervention for individuals with ASD have been recently published (e.g., Duffy & Healy, 2011; Ganz, Earles-Vollrath, et al., 2012; Ramdoss et al., 2011), a review specific to teaching question-asking skills is warranted because of the aforementioned importance of question-asking skills. In this systematic review, we provide an overview of studies in which participants with ASD received intervention specifically designed to improve question-asking skills. Each included study is summarized in terms of participant characteristics, types of question-asking skills taught, the intervention components that were implemented, the study's research design, and the outcomes for participants. A review of this nature is intended to elucidate potential directions for future research and to help practitioners identify evidence-based interventions.

1. Methods

This review consisted of a systematic search and analysis of studies that provided intervention to teach individuals with ASD to ask questions or improve existing question-asking skills. First, a systematic search procedure was implemented. Next, predetermined inclusion criteria were applied to studies returned by the search. Included studies were then summarized by two or more co-authors independently and these summaries were then checked for accuracy across co-authors.

1.1. Search procedures

Systematic searches were conducted in four electronic databases: Education Resources Information Center (ERIC), Psychology and Behavioral Sciences Collection, Medline, and PsycINFO. The search was limited to peer-reviewed studies written in English. To focus the search on studies most likely to meet the inclusion criteria, three lists of key terms were created. List 1 included terms or phrases related to question-asking skills (i.e., “question*”, “mand* for information,” “request* information,” and “Wh question”). List 2 included terms related to intervention (i.e., “intervention,” “teach*,” “therap*,” and “treatment”). List 3 involved terms related to ASD diagnosis (i.e., “auti*,” “PDD-NOS,” and “Asperger*”). Each search included one term from each list (e.g., “question*”, and “intervention”, and “autis*”) that was inserted as free text into the keyword fields. All possible combinations of terms across lists were searched separately. Two co-authors independently screened the returned abstracts from the search to identify studies for possible inclusion in this review. The reference lists of the studies identified for possible inclusion by each co-author were then reviewed to identify additional studies for possible inclusion. Finally, to identify studies that had not yet been uploaded to the electronic databases, hand searches that covered the period January 2011 to January 2012 were conducted for each journal that had published an included study. A total of 37 studies were considered for possible inclusion during this process.

1.2. Inclusion and exclusion criteria

To be included in this review, a study had to meet two inclusion criteria. First, the study included at least one participant diagnosed with autism, Asperger syndrome, or pervasive developmental disorder-not otherwise specified (PDD-NOS).

Second, the study evaluated an intervention that was aimed at teaching the participants to ask questions verbally or by using some form of augmentative and alternative communication (AAC) system or device (e.g., picture exchange or speech generating device). Studies in which data exclusive to question-asking could not be disaggregated from other dependent variables were excluded (e.g., Charlop, Gilmore, & Chang, 2009). These criteria were determined prior to beginning the systematic search in order to reduce potential bias regarding study inclusion. Ultimately, 21 studies were identified for inclusion.

1.3. Data extraction

The 21 included studies were summarized in terms of the following features: (a) participant characteristics, (b) dependent variables, (c) intervention procedures, (d) research design, and (e) intervention outcomes. Because all of the included studies used single-case research designs (Gast, 2010), visual analysis of graphed data was used to assess outcomes.

1.4. Reliability and inter-coder agreement

To ensure accuracy in the application of inclusion criteria, the 37 studies that resulted from the systematic search, and the initial application of the inclusion criteria, were independently examined by two co-authors. Agreement as to whether a study should be included or excluded was obtained for 35 out of the 37 studies (95%). A third author then reviewed the two studies on which there was initial disagreement. This trio then discussed the disputed articles until a consensus was reached.

After the final list of included articles was agreed upon, each study was coded in terms of (a) participant characteristics, (b) dependent variable, (c) intervention procedures, (d) research design, and (e) outcomes. To ensure the accuracy of these summaries, co-authors not involved in the initial data extraction/summary used a checklist to evaluate inter-coder agreement. The checklist included five questions regarding each study's summary: (a) Is this an accurate description of the participants? (b) Is this an accurate description of the intervention procedures? (c) Is this an accurate description of the dependent variables? (d) Is this an accurate description of the research design? and (e) Is this an accurate description of the outcomes? Co-authors were asked to read the study and summary, and then complete the checklist. In instances in which the summary was not considered accurate, the co-authors edited the summary to improve accuracy. This process continued until 100% agreement was reached on all summaries. Table 1 was created from the resulting summaries.

2. Results

Table 1 summarizes each of the 21 included studies.

2.1. Participants and intervention settings

Collectively, the 21 studies provided intervention to a total of 62 participants with ASD. Fifty participants were male (81%) and 12 female (19%). This is consistent with the male to female ratio within the ASD population (American Psychiatric Association, 2000). Thirty-six of those participants (58%) had a diagnosis of autism, 1 had an additional diagnosis of cerebral palsy; 1 participant (2%) had a diagnosis of PDD-NOS; and the remaining 25 participants (40%) were described as having ASD, with no specific diagnosis given. The ages of the participants ranged from 2 years 9 months to 25 years ($M = 7$ years, 9 months old). Of the studies that reported level of intellectual functioning, four participants (6%) had an intellectual disability (ID), but the level of ID was not reported for these participants. For the participants in 17 studies (81%) the level of intellectual functioning was not reported.

Intervention was implemented in various settings. School settings were used in 52% of studies ($n = 11$) (e.g., Betz, Higbee, & Pollard, 2011; Ostryn & Wolfe, 2011a; Williams, Perez-Gonzalez, & Vogt, 2003). Clinic settings accounted for 9% of reviewed studies ($n = 2$) (Koegel, Koegel, Green-Hopkins, & Barnes, 2010; Palmen, Didden, & Arts, 2008). Participant homes were used in 19% of the reviewed studies ($n = 4$) (Esbenshade & Rosales-Ruiz, 2001; Marion, Martin, & Yu, 2011; Roy-Wskiak, Marion, Martin, & Yu, 2010; Williams, Donley, & Keller, 2000). One study was conducted at a summer camp (Hung, 1977), and one employed an intervention during an after-school program (Charlop & Milstein, 1989). More than one setting was used in 9% of studies ($n = 2$) to assess generalization across settings (Koegel, Camarata, Valdez-Menchaca, & Koegel, 1998; Koegel et al., 2003).

2.2. Dependent variables

Various forms of questions (i.e., dependent variables) were targeted throughout the reviewed studies. *What* questions were taught in 48% of studies ($n = 10$), making them the most common dependent variable (e.g., Hung, 1977; Koegel et al., 2003; Marion et al., 2011; Taylor & Harris, 1995). *Where* questions comprised 29% of reviewed studies ($n = 6$) (e.g., Endicott & Higbee, 2007; Koegel et al., 2010; Lechago, Carr, & Grow, 2010).

In 38% of reviewed studies ($n = 7$), multiple question forms were targeted (e.g., Endicott & Higbee, 2007; Ostryn & Wolfe, 2011b; Shillingsburg, Valentino, & Bowen, 2011). For example, Ostryn and Wolfe (2011b) taught participants to expressively

Table 1
Summary of included studies.

Citation	Participant characteristics	Dependent variables involving question-asking	Intervention procedures	Research design and outcomes involving asking questions
Betz et al. (2010)	2 males, ages 3;5 and 5 years old, 1 female, age 4;5 years old, all with ASD	Percentage of independent mands for information using “Where + [item name]?” per session	Trials began with 30 s access to a toy identified via preference assessment. The toy was then hidden from the participant by the therapist and the verbal discriminative stimulus, “Let’s play. Get [item]” was given. Echoic prompts and a 5-s time delay procedure were used to elicit “Where [item]?” from participants. Generalization probes were conducted with novel toys in the training setting, novel toys in a novel setting, and interrupted chain procedure was implemented within a natural behavior chain with no specific verbal discriminative stimulus.	<i>Research design:</i> Multiple baseline across participants. <i>Outcomes:</i> All 3 participants acquired the initial skill targeted, “Where [item]?”, and demonstrated generalization with novel toys in the training setting and with novel toys in a novel setting. Generalization to a natural behavior chain did not occur until training using an interrupted chain procedure was implemented.
Charlop and Milstein (1989)	3 males, ages 6;10, 7;6, and 7;10 years old, all with ASD	Number of appropriate questions	Video modeling was used to teach scripted conversations about preferred toys. The participant was shown a videotaped conversation 3 times. Therapist said, “Let’s do the same,” and paused before providing the first line of conversation. If criterion was not met, the video was shown again and the child was tested afterward. During probes, child and therapist held the same toys as in the video. Correct responses were acknowledged, questions were answered, and access to requested toys was provided. Reinforcement in the form of edibles and verbal praise was provided for sitting still, attending, and talking.	<i>Research design:</i> Multiple baseline across participants, withdrawal design embedded within participants, and multiprobe across conversations. <i>Outcomes:</i> All participants increased question-asking skills, generalization across people, settings, stimuli, and conversation topics was reported. Maintenance was demonstrated at 15 months.
Endicott and Higbee (2007)	4 males, ages 3, 4, 4, and 5 years old, all with ASD	(a) Percentage of correct mands for “Where?” and (b) Percentage of correct mands for “Who?”	Trials began by providing participants access to a preferred item identified via preference assessment for 30 s. The item was then hidden in one of 3 potential places while the participant was not looking. The participant was then told “Get [item]”. After an incorrect or no response, an echoic prompt “Say, ‘Where [item]?’” was given. Contingent on correct mand the instructor gave the location of the missing item and 30 s of access to the item was provided following retrieval. In a second phase identical procedures were used except the item was given to another person and the participant was prompted to ask, “Who has [item]?”	<i>Research design:</i> A multiple baseline across participants with a generalization phase was used for each dependent variable. A multielement design within each multiple baseline evaluated the intervention using high-preferred and less-preferred items. <i>Outcomes:</i> All participants acquired the mand “Where [item]?” for highly preferred items and 2 of the 3 participants acquired this mand for low-preferred items. Two participants generalized <i>where</i> questions from clinic to home. All 3 participants acquired the mand “Who has [item]?” for high- and low-preferred items.
Esbenshade and Rosales-Ruiz (2001)	1 male, age 5 years old, with autism	Number of questions asked in the presence of unknown and known items	The child was shown items for which they knew the names and then asked, “What is this?” by the therapist. If the child did not respond correctly within 5 s, the therapist delivered the vocal model prompt “Say, What is that?” The child was praised and given information about the name of the item contingent upon correct imitation of “What is that?”. Generalization across different instructional tasks was assessed using the variations of the discriminative stimulus and across caregivers. If generalization did not occur after the initial training procedures, programming common stimuli was used to facilitate generalization.	<i>Research design:</i> A combination of pre-experimental AB designs and a within session cumulative record. <i>Outcomes:</i> The number of questions asked when presented with unknown items increased during all tasks with the exception of the generalization task in which the participant was told to “Give this to [person’s name].” Following inclusion of programming common stimuli across tasks, generalization occurred for all tasks.

Table 1 (Continued)

Citation	Participant characteristics	Dependent variables involving question-asking	Intervention procedures	Research design and outcomes involving asking questions
Hung (1977)	2 males, ages 9:2 and 10:8 years old and 1 female, age 8:1 years old; all with autism (child with schizophrenia was excluded)	(a) Daily frequency of the questions "What is/are [object name] for?" and "What is/are [name of person] doing?" and (b) Means of spontaneous questions (i.e., no prompt within previous 30 s) per hour during non-training times	Participants were shown picture cards of nouns and verbs and occasionally real objects in a classroom setting of a summer camp. A time delay and echoic prompt were used to prompt target questions about objects and cards. During scheduled sessions and outside of the classroom, spontaneous questions were reinforced with praise, tokens (token exchange rate was also systematically manipulated), or edibles plus answers to questions. Repetitious questions received only praise. Generalization training involved the same reinforcement and least-to-most prompting and was conducted in a more natural setting within the classroom. Follow-up data on question-asking were collected at 11 months without additional classroom training for 2 of the 3 participants.	<i>Research design:</i> Classroom training was evaluated within a pre-experimental AB design and generalization was evaluated in a multiple baseline across participants. <i>Outcomes:</i> All participants learned to ask questions in the classroom training setting. However, participants did not spontaneously ask questions outside of the classroom until the token value was increased. During maintenance, the 2 participants were not receiving tokens and asked no questions.
Ingvarsson and Hollobaugh (2010)	4 males, ages 4, 6, 7, and 10 years old, all with autism	Number of times participants mandated for information using the phrase, "I don't know. Please tell me."	Pretest with 56 questions was administered to create lists of questions for which participants knew the answer (known) and questions for which they did not know the answer (unknown). A set of unknown questions was targeted. Echoic answers to questions. Two of the participants generalized prompts and time delay were used to teach the phrase which functioned as a mand for information. For 2 participants, edible reinforcers were used, and for 1 of those 2 participants, gradually faded.	<i>Research design:</i> Nonconcurrent multiple baseline across participants. <i>Outcomes:</i> All 4 participants acquired the target mand for the phrase across questions. The other 2 participants acquired the phrase after edibles were added. Overall generalization probes yielded mixed results, but some form of generalization was demonstrated for all 4 participants.
Koegel et al. (1998)	2 males, ages 3:11 and 5:4 years old, and 1 female, age 3:9 years old, all with autism	Number of times the child spontaneously asked, "What's that?"	Preferred items were put in an opaque bag, and the participants were taught to ask, "What's that?" using an echoic prompt. Questions were reinforced with access to the item and the answer. After the child spontaneously asked, "What's that?" consistently over several sessions, less preferred items (novel items) were used. Generalization probes were conducted under 2 conditions (a) in response to new items in the clinic while the child engaged in play/social interactions with a clinician and (b) in response to new items at the child's home while the child engaged in play/social interaction with his/her mother.	<i>Research design:</i> Multiple baseline across participants. <i>Outcomes:</i> All 3 participants increased spontaneous asking, "What's that?", during intervention. All participants generalized across settings (home) and to new stimuli (novel items).
Koegel et al. (2003)	2 males, ages 4:4 and 6:3 years old, both with autism	<i>Child 1:</i> (a) Number of occurrences of regular past tense verb productions, (b) Number of productions of "What happened?", and (c) Percentage of correct responses using regular past tense. <i>Child 2:</i> (a) Number of occurrences of present progressive verb productions, (b) Number of productions of "What's happening?", and (c) Percentage of correct responses using the present progressive	Participants were taught to use a self-initiated query ("What happened?" or "What's happening?") using pop-up books and vocal model prompting. After the participant asked the question, the clinician responded with the appropriate verb stem-plus-temporal morpheme.	<i>Research design:</i> Multiple baseline across participants. <i>Outcomes:</i> Participants improved on all dependent measures. Generalization to other question forms was demonstrated.

Koegel et al. (2010)	3 males, ages 3:2, 3:4, and 4:8 years old, all with autism	Percentage of unprompted “Where is it?” questions per session and of unprompted correct prepositional/ordinal markers	Preferred items (e.g., candy or toys) were hidden. Participants were prompted to ask, “Where is it?” with an echoic prompt. The clinician responded to questions with a targeted preposition (e.g., <i>on</i> the table, <i>under</i> the doll, etc.). Echoic prompts were then faded. Approximately every 5th intervention session, pre-session probes assessed if the participant had acquired a preposition as an expressive language structure. The clinician asked the child, “Where is the [item]?” to probe this skill.	<i>Research design:</i> Multiple baseline across participants. <i>Outcomes:</i> All 3 participants increased their question-asking from 0% to an average of 85–99.7% during intervention and generalized the skill to the home. All 3 participants exhibited an increase in correct use of expressive language structures (preposition/ordinal words) corresponding to the questions they asked.
Lechago et al. (2010)	3 males, ages 4:6, 4:6, and 7 years old, all with autism	Cumulative number of correct mands for information: “Where spoon?” or “Who has [the] spoon?”	Participants were taught behavior chains for a specific task (i.e., making a baking soda volcano) using total task presentation. An interrupted-behavior-chain procedure was then used to establish motivation for information. Vocal model prompts were used to teach the mands “Where spoon?” or “Who has [the] spoon?” during the activity interruptions. Mands that occurred within 10 s of interruption were reinforced with information. The participant learning the <i>where</i> mand was given information regarding the location of the spoon (e.g., “It’s in the green drawer”). The 2 participants learning the <i>who</i> mand were given information related to an instructor wearing a colored shirt (e.g., “Blue has the spoon”). A 2 s time delay was used before delivery of an echoic prompt for the targeted mand. Other behavior chains (e.g., making flavored milk, setting a table) were used to probe for generalization across establishing operations.	<i>Research design:</i> Nonconcurrent multiple baseline across participants. <i>Outcomes:</i> All 3 participants acquired the target skill and generalized the response across the activities. For 2 participants, the question generalized to asking for information using an untaught noun (i.e., truck).
Marion et al. (2011)	3 males, ages 5:7 8:5 (with ASD), and 4 years old (with autism)	Correct use of the question “What is it?”	A questionnaire was used to identify preferred activities. Motivating situations involving: hide and seek, missing items, requiring more of something, and telling the participant there was a surprise were contrived for each activity and vocal and non-vocal scripts, designed to elicit the question, were created for each situation. An echoic prompt (i.e., “Say, ‘What is it?’”) was faded using a progressive time delay and the intensity of the prompt (i.e., partial echoic prompts). Provision of the requested information related to continuation of the activity was contingent on correct questions. Trials were presented again following errors.	<i>Research design:</i> Multiple baseline across situations and activities that motivated questions for each participant. <i>Outcomes:</i> All 3 participants acquired the skill for each motivating situation and activity and generalized to the natural environment and a novel activity. Maintenance at 4 weeks was demonstrated.
Ostryn and Wolfe (2011a)	1 male, age 4 years old with PDD-NOS, 2 females, ages 3 and 4 years old, both with ASD	Independent correct use of “What’s that?”, initially communicated by pictures and then vocally	Therapist held a bag containing items and modeled the “What’s that?” question, then waited 2 s for participants to imitate before using most-to-least prompting for the picture exchange. Contingent upon questions, participants were told people, and settings. Maintenance was demonstrated for 1 the name of the item. After the participant requested the item s/he was given access to it. Pictures were faded. Two of the participants began echoing the prompt, and least-to-most prompting with vocal model prompts was implemented. The third participant’s response was changed to a verbal approximation and gesture.	<i>Research design:</i> Multiple baseline across participants. <i>Outcomes:</i> All 3 participants learned to ask, “What’s that?”. Generalization occurred for all participants across stimuli, and settings. Maintenance was demonstrated for 1 participant at 3 months and 2 participants at 6 months.

Table 1 (Continued)

Citation	Participant characteristics	Dependent variables involving question-asking	Intervention procedures	Research design and outcomes involving asking questions
Ostryn and Wolfe (2011b)	1 male, age 3:5 years old, and 2 females ages 4:2 and 4:11, all with ASD	Correct and unprompted utterance of "What's that?" or "Where is it?" in which the participant had to determine which question was appropriate for the context	Preference assessments were conducted to determine preferred items. An item was placed in a bag and participants were prompted to ask, "What's that?" using an echoic prompt and a 2 s time delay. Contingent on target response, participants were shown the item and given information about it (e.g., name of item, color, size, sounds it made). When the participant requested the item or responded to the questions "Would you like to see it?" or "Would you like to play with it/have it?", 20 s of access was allowed. To teach "Where is it?", participants were presented with a container and directed to "Get your [item]," then had free access to the item. Next, the investigator covertly removed the item, presented the empty container, and said, "Get your [item]." An echoic prompt was used to teach, "Where is it?" After each teaching session, a discrimination session involving both questions with no prompting was implemented.	<i>Research design:</i> Multiple baseline across participants. <i>Outcomes:</i> All 3 participants learned to ask both questions to discriminate when to use each question.
Palmen et al. (2008)	7 males and 2 females (<i>M</i> age = 19, range 17–25 years old), all with high functioning ASD	Percentage of correct questions during a tutorial conversation and response efficiency; specifically, questions were scored correct if they were (a) asked within 5 s, (b) were related to the topic of conversation, and (c) began with an interrogative or a verb	Groups of 3 participants received sessions involving introduction (aim of training explained), evaluation of simulated conversations, and role play/table game. A flow chart was used during intervention to guide conversation and provide corrective feedback. Least-to-most prompting was used during the correction procedure (indirect verbal instruction, direct verbal instruction, and finally modeling the correct response). Participants earned points for correct questions asked during the table game, which could later be exchanged for prizes.	<i>Research design:</i> Nonconcurrent multiple baseline across 3 groups of 3 participants. <i>Outcomes:</i> Percentage of correct questions increased for all participants from baseline to training. Response efficiency increased or remained stable at 100% from baseline to training. Both dependent variables for all participants remained above baseline levels at 1-month follow-up.
Roy-Wskiak et al. (2010)	1 male, age 5 years old, with autism	Percentage of correct independent uses of "What?"	Four activities (hide and seek, missing item needed for task, requiring more, and surprise) designed to motivate the question "What?" were contrived during sessions. Scripts were used as verbal discriminative stimuli to elicit the question. Scripts included statements such as: "Let's add something," "put something away," and "I brought you something." Training consisted of prompting the response using an echoic prompt that was faded with partial vocal models and a progressive time delay. Contingent on the question "What?" information and the missing or needed item required for the activity was provided.	<i>Research design:</i> Modified multiple baseline across activities. <i>Outcomes:</i> Use of "What?" increased during all 4 activities and generalized to untrained scripts, settings, and novel activities. Results maintained at 1, 2, and 4 weeks.
Shillingsburg et al. (2011)	2 males, ages 7:9 and 11:11 years old, both with autism and one with comorbid cerebral palsy	Percentage of correct uses of "Who," "Which," and "When" for one participant and "Who," "Where," and "When" for the other participant	Preference assessments were used to determine preferred items. Four activities designed to motivate the question were contrived during sessions for each question taught. As a part of the antecedent manipulation, nonverbal and verbal discriminative stimuli were presented. For example, 3 therapists were present and the participant was told "Someone has a surprise for you," then a least-to-most prompting procedure (moving from only non-verbal and verbal discriminative stimuli to adding an echoic prompt) with 3 s time delay was used to teach the question.	<i>Research design:</i> Multiple probe across questions. <i>Outcomes:</i> Both participants learned to ask 3 different questions across 4 scenarios. Generalization across types of questions (e.g., <i>who</i> and <i>what</i>) did not occur. However, once acquired, generalization of a specific question did occur across situations. One participant maintained all questions, with last question probed at 18 days. The other participant was assessed for maintenance between 4 and 10 weeks and all questions were maintained except for 2 scenarios involving <i>where</i> .

Shillingsburg and Valentino (2011)	1 male, age 7:8 years old with autism	Independent use of "How?"	High-preferred activities were identified by caregivers and were used to motivate the question (e.g., locked gate to swing, unplugged computer monitor and batteries missing from remote). The participant selected a specific activity for each session. An echoic prompt was immediately presented on the first trial each session. Subsequent trials included a 5 s time delay to allow an independent response. Contingent on independent asking of "How?" information regarding how to complete the activity and access to the preferred activity was provided.	<i>Research design:</i> Multiple baseline across activities. <i>Outcomes:</i> Independent use of the question "How?" increased across all 6 activities and generalized across activities after the first two were directly taught.
Sundberg et al. (2002)	<i>Experiment 1:</i> 2 males, ages 5 and 6 years old, both with autism. <i>Experiment 2:</i> Participant 1 from experiment 1 (age 5 year old) and another male, age 8 years old, with autism.	<i>Experiment 1:</i> Percentage of correct use of "Where?" and "Who?" and, in the last sessions, the latency between incorrect use of "Where?" and stimulus, "I gave it to a teacher" and the question being directed to the correct teacher. <i>Experiment 2:</i> Correct use of "Where?" and "Who?" and, in the last sessions, the latency between distraction activity, the item was placed in 1 of the other 2 containers. Then the participant was presented with an empty container and told, "Get your [item]." Echoic or imitative (sign) prompts were used and faded using partial prompts and time delay. Correct responses were followed by the information of the location of the item.	<i>Experiment 1:</i> Two sets of items (one reinforcing set and one neutral set) were chosen for each participant. Two items (one from each group) were chosen and placed in 1 of 3 containers (a box, bag, or can). Participants were told, "Get your [item]" allowed brief contact with the item, then distracted. During the intervention, the item was placed in 1 of the other 2 containers. Then the participant was presented with an empty container and told, "Get your [item]." Echoic or imitative (sign) prompts were used and faded using partial prompts and time delay. Correct responses were followed by the information of the location of the item. <i>Experiment 2:</i> The same procedures for Experiment 1 were in place except, when the participant asked, "Where [item]?", the experimenter responded with "I gave it to a teacher". One of 3 teachers in the room had been covertly given the item. The participants were prompted to ask, "Who has it?", and were reinforced with the requested information.	<i>Research design:</i> Multiple baseline assessed performance across questions and a multielement design compared preferred item to neutral item set within each participant. A multiple baseline across participants also evaluated the intervention. <i>Outcomes Experiment 1:</i> Both participants increased use of questions about the location of items. For Participant 1, the preferred item question was acquired first. For Participant 2, the less preferred item question was acquired more quickly. Participant 1 asked about location of preferred items without training, but did not do so with neutral items. Participant 2 did not generalize across item sets. <i>Outcomes Experiment 2:</i> Both participants learned to ask, "Who has it?", with similar results for both preferred and non-preferred items. Both participants showed a shorter latency between the verbal stimulus "I gave it to a teacher" and the question "Who has it?" for desired items than for undesirable items. Maintenance was probed for 1 participant and skills were maintained at 6 months.
Taylor and Harris (1995)	2 males, ages 5 and 9 years old, and 1 female, age 9 years old, all with autism	Percentage of correct independent asking "What's that?" while pointing to an unknown stimulus	Pretests classified pictures that participants could and could not expressively identify. During intervention, 4 pictures were placed on a table. The instructor said, "Tell me what you see on the table." Participants were taught to label pictures from left to right. When the participant pointed to an unknown picture, the experimenter vocally modeled, "What's that?", in an exaggerated questioning tone of voice. Contingent on imitation, the item label and a tangible reinforcer were given. After the child imitated "What's that?" for 3 consecutive trials, the experimenter increased the time delay from 0 to 2 s. Physical prompts to occasion pointing were used and then gradually faded. Time delay was further faded to 10 s. Participants were then taught to ask, "What's that?", while on a walk around the school. When they approached a novel object, the experimenter paused approximately 1 m from the object for 1 s to assess whether the child would point and ask, "What's that?". Prompting was provided using a gradual, progressive time delay.	<i>Research design:</i> Multiple baseline across participants. <i>Outcomes:</i> All participants learned to ask, "What's that?", when presented with unknown pictures and while on a school kitchen with a different adult.

Table 1 (Continued)

Citation	Participant characteristics	Dependent variables involving question-asking	Intervention procedures	Research design and outcomes involving asking questions
Williams et al. (2000)	2 females, both 4 years old, both with autism	Frequency of asking "What's that?", "Can I see it?", and "Can I have it?"	The experimenter held a box and commented about an object inside. The participant was prompted to ask, "What's that?", using echoic prompts. The box and object were given contingent on asking. Prompts were gradually faded, and when the participant initiated the question independently, training on the next question form began. During training on the second response, the experimenter told the child the name of the object when she asked, "What's that?", but did not give the box. Next, "Can I see it?" was targeted, and access to the box and item was again made contingent. Finally, "Can I have it?" was targeted and the other two questions only produced the name and sight of the item, while only the final target question resulted in access to the box.	<i>Research design:</i> Multiple baseline across questions. <i>Outcomes:</i> Both participants learned to ask all 3 questions and generalized the skills across people (i.e., to mothers) and setting (i.e., living room). Skills maintained at 20 days for participant 1 and 11 months for participant 2.
Williams et al. (2003)	3 males, ages 2:9, 4:5, and 9:4 years old, all with autism	Frequency of asking "What's in the box?", "Can I see it?", and "Can I have it?"	First, the procedures described in Williams et al. (2000) were implemented and all participants acquired all 3 questions. Next, the following phases were implemented: (a) contingent on, "Can I see it?", the experimenter said, "No!", and the box was only given if the participant asked, "Can I have it?", (b) the experimenter hid the box behind her back and the same contingencies remained in place, (c) prompts were stopped and the original contingencies were reinstated. If the participant only asked, "What's in the box?", then "Can I have it?" he was told, "Sure, you can have it", and given the box, (d) out of 10 trials randomly contained non-preferred objects, (e) all trials contained unpleasant objects, and (f) the participant was told "No!" to the question "Can I have it?" but was told "Sure!" and given the box contingent on the question "Can I see it?"	<i>Research design:</i> Multiple baseline across participants with each of phases presented in procedures presented in order for participants 1 and 2, but a subset of those procedures for participant 3 during the final phase. <i>Outcomes:</i> All participants learned to ask all 3 questions in the first teaching phase. The purpose of the subsequent phases was to determine how differing consequences would affect the relative rate of specific questions. Results suggest that each question was maintained by different contingencies and can be classified as independent repertoires of behavior.

discriminate between “What’s that?” and “Where is it?” Further, Williams et al. (2000, 2003) employed interventions targeting the questions: “What’s in the box?”, “Can I see it?”, and “Can I have it?”

Both *where* and *who* questions were targeted in 14% of the reviewed studies ($n = 3$) using two separate experiments. Specifically, after participants acquired the *where* question during the first experiment, a second experiment was conducted in which the *who* question was taught (Endicott & Higbee, 2007; Lechago et al., 2010; Sundberg, Loeb, Hale, & Eigenheer, 2002).

Shillingsburg et al. (2011) was the only study included in this review that involved instruction on four different *wh*-questions: *who*, *which*, *where*, and *when*. Moreover, Shillingsburg and Valentino (2011) targeted a *how* question. Finally, Ingvarsson and Hollobaugh (2010) taught the mand for information: “I don’t know. Please tell me.” As such, this is the only study in this review that taught a mand for information that was not technically [grammatically] a question, but it does serve the same function as a *what* question (i.e., the participant is told the name of an object as reinforcement).

2.3. Intervention procedures

All of the included studies implemented a multicomponent behavioral intervention. All 21 studies applied systematic prompting and prompt fading procedures (e.g., time delay). The most common type of prompt was a vocal model, or echoic prompt, which was used in 95% ($n = 20$) of the studies (e.g., Endicott & Higbee, 2007; Marion et al., 2011; Shillingsburg et al., 2011). Other prompts included a video model (Charlop & Milstein, 1989), a picture exchange model (Ostryn & Wolfe, 2011a), indirect and direct verbal instructions (Palmen et al., 2008), and an imitative/sign model (Sundberg et al., 2002).

Different forms of reinforcement were used throughout the studies. Provision of information (i.e., the answer to the question) was the natural consequence that was hypothesized to function as reinforcement in all reviewed studies. Additionally, 91% of studies ($n = 19$) included supplementary [contrived] reinforcement in the form of access to a preferred item/activity/edible or tokens/points paired with contingent information. The most common supplementary reinforcement was either access to an item or continuation of an activity related to the question, which was applied in 67% of studies ($n = 14$) (e.g., Betz et al., 2010; Marion et al., 2011; Shillingsburg & Valentino, 2011). Edible reinforcement was used in 19% of studies ($n = 4$) (Charlop & Milstein, 1989; Hung, 1977; Ingvarsson & Hollobaugh, 2010; Taylor & Harris, 1995). Tokens or points, which could be exchanged for backup reinforcers, were used in 14% of studies ($n = 3$) (Hung, 1977; Palmen et al., 2008; Taylor & Harris, 1995).

A commonly employed intervention strategy was to contrive an establishing operation (EO), wherein motivation for asking questions was created within the context of an activity; 67% of reviewed studies ($n = 14$) used this type of EO technique (e.g., Betz et al., 2010; Koegel et al., 1998; Shillingsburg et al., 2011). Specifically, to contrive an EO for participants to ask questions, the teaching environment was often strategically arranged by hiding highly preferred or interesting items in containers or with the instructor. Contingent upon the participant asking a *where* question, information regarding the location of the missing item was provided (e.g., Betz et al., 2010; Endicott & Higbee, 2007; Sundberg et al., 2002).

Verbal discriminative stimuli in the form of scripts (e.g., “I hid something”) or directives (e.g., “Get your [item name]”) were used to set the occasion for a question in 48% of studies ($n = 10$) (e.g., Marion et al., 2011; Shillingsburg & Valentino, 2011; Sundberg et al., 2002). Marion et al. (2011) taught participants to ask, “What is it?” using scripts as discriminative stimuli. For example, during an activity designed to motivate the child to ask, “What is it?”, the instructor used a script in which the phrase, “Oh no!” was intended to set the occasion for the target response. Specifically, while making a model volcano, only a small amount of vinegar was provided, and the volcano failed to erupt. The instructor said, “Oh no!” with her hands and palms up, and the participant asked, “what is it?” The instructor then provided the information required to continue the activity (i.e., “We need more vinegar.”), and the activity resumed.

An interrupted behavior chain procedure was used in 10% of studies ($n = 2$) (Betz et al., 2010; Lechago et al., 2010). Participants were taught to ask *where* or *who* questions during a multi-step behavioral sequence (chain) with one critical stimulus missing. For example, the participant was told, “It’s time to color,” then walked to a shelf and retrieved paper and a crayon box and sat down at the table. When she opened the box, the crayons were missing, which was intended to create the need for a *where* question (Betz et al., 2010).

Discrete trial training was implemented in 33% of studies ($n = 7$) (e.g., Esbenschade & Rosales-Ruiz, 2001; Ingvarsson & Hollobaugh, 2010; Taylor & Harris, 1995). For example, participants were presented with a discriminative stimulus (S^D) and taught to request information (e.g., “What’s that?”). The delivery of information served as positive reinforcement. Other intervention components utilized include video modeling (Charlop & Milstein, 1989) and small group social skills instruction (Palmen et al., 2008).

2.4. Research design

All of the studies used single-case research designs (Gast, 2010). Multiple baseline designs were used in 59% of studies ($n = 13$) (e.g., Esbenschade & Rosales-Ruiz, 2001; Palmen et al., 2008; Shillingsburg & Valentino, 2011), multiple probe designs were used in 5% of studies ($n = 1$) (Shillingsburg et al., 2011), a non-concurrent multiple baseline was used in 14% of studies ($n = 3$) (Ingvarsson & Hollobaugh, 2010; Lechago et al., 2010; Palmen et al., 2008), and 23% of the studies ($n = 5$) used a combination of research designs (e.g., Charlop & Milstein, 1989; Sundberg et al., 2002, Experiment 1; Sundberg et al., 2002, Experiment 2). In all of the studies, interobserver agreement (IOA) data were collected, and the reported IOA percentages

were on average greater than 80%. Finally, procedural integrity checks were conducted in 27% of studies ($n = 6$) with 80% or greater integrity reported (e.g., Betz et al., 2010; Lechago et al., 2010; Marion et al., 2011).

2.5. Outcomes

While all of the reviewed studies reported positive outcomes with regard to acquisition of question-asking skills, generalization effects were mixed. Various generalization measurements were collected in 81% of the reviewed studies ($n = 17$) (e.g., Hung, 1977; Shillingsburg et al., 2011; Williams et al., 2000). These included assessing generalization across (a) instructional stimuli, (b) settings, (c) people (i.e., conversation partners), and (d) time (i.e., maintenance).

Effects of generalization across instructional stimuli in the form of materials, activities, or tangible items were measured in 62% of the reviewed studies ($n = 13$) (e.g., Koegel et al., 1998; Lechago et al., 2010; Roy-Wskiaki et al., 2010). Nine of those studies reported positive results (e.g., Lechago et al., 2010; Roy-Wskiaki et al., 2010; Sundberg et al., 2002). Generalization across settings was measured in 53% of studies ($n = 11$), and positive results were reported by 10 of those studies (e.g., Endicott & Higbee, 2007; Koegel et al., 1998; Taylor & Harris, 1995). Generalization across people (i.e., conversation partners) was measured in 38% of studies ($n = 8$) (e.g., Charlop & Milstein, 1989; Esbenschade & Rosales-Ruiz, 2001; Williams et al., 2000). Positive results regarding generalization across people were reported by five studies (Endicott & Higbee, 2007; Koegel et al., 1998; Ostryn & Wolfe, 2011a; Taylor & Harris, 1995; Williams et al., 2000).

Maintenance probes, ranging from six days to 15 months ($M = 16$ weeks), were collected in 43% of the reviewed studies ($n = 9$) (e.g., Charlop & Milstein, 1989; Roy-Wskiaki et al., 2010; Shillingsburg et al., 2011). Only one study reported negative results during follow-up (Hung, 1977).

3. Discussion

We identified and summarized 21 studies that involved teaching question-asking skills to individuals with ASD. The approaches to intervention in these studies shared several common components. Specifically, those components included: (a) ensuring participants are motivated to ask questions by identifying preferred items and/or activities and strategically arranging the instructional environment (i.e., contriving EOs), (b) using information and access to preferred items or activities as positive [natural] reinforcement for question-asking, and (c) using systematic prompting and prompt fading (e.g., time delay). Each of these components is discussed in more detail below.

Ensuring the presence of a motivating EO is generally considered to be essential for effectively training individuals with ASD to ask questions (Hartman & Klatt, 2005; Sundberg & Michael, 2001; Sundberg & Partington, 1998). Across the reviewed studies, several procedures were used to ensure the participants were motivated to ask questions. One approach simply involved selecting a time and or place that was likely to evoke question-asking. For example, someone who has not eaten recently is likely to be more motivated to ask questions about the availability of food (e.g., When is dinner?) than someone who has just eaten a meal and is not in an environment where food is typically served (Langthorne & McGill, 2009). A second way to ensure motivation might be to use items and activities in the intervention that the participant prefers. For example, it may be easier to teach a child with ASD to ask the question “Where is my stuffed bear?” if the stuffed bear is a preferred item, but the child does not have possession of the bear (i.e., the toy bear is missing). In most of the reviewed studies systematic preference assessments were used to identify stimuli and activities likely to function as reinforcers. Marion et al. (2011) used a parent questionnaire to identify participants’ preferences, which were then incorporated into different activities. Other studies employed direct preference assessments involving observation of participants’ interactions with items to determine which items they preferred (e.g., Betz et al., 2010; Endicott & Higbee, 2007; Sundberg et al., 2002). Finally, motivation was established via environmental arrangement. For example, preferred items were hidden in the environment to motivate *where* questions.

Reinforcement in the form of providing answers to questions (e.g., telling the child the location of a preferred item or information related to continuation of a preferred activity) was used in all of the reviewed studies. However, several of the studies emphasize the importance of pairing answers with some form of contrived (tangible) reinforcement to facilitate initial skill acquisition (e.g., Betz et al., 2010; Lechago et al., 2010; Marion et al., 2011). For example, tokens or edibles might be given in tandem with answers to provide additional reinforcing consequences for the target behavior. It is important to note that, while the addition of tangible reinforcers might facilitate acquisition, the use of such contrived reinforcement might also hinder generalization if these contrived reinforcers are not typically available in the natural environment and are not faded during the intervention process (Skinner, 1982; Stokes & Baer, 1977). It would also seem important for the participants with ASD to have sufficient receptive language skills (i.e., an adequate listener’s repertoire) to act on the answers they receive.

All of the reviewed studies also implemented systematic prompting and prompt fading procedures to teach target questions. The most common type of prompt was an echoic prompt, which involved the therapist demonstrating or modeling the question for the participant (e.g., Endicott & Higbee, 2007; Marion et al., 2011; Shillingsburg et al., 2011). At first participants are reinforced for prompted questions, but gradually response requirements are increased and prompts are faded so that participants must ask questions with less support from the therapist. Various prompt fading procedures were applied across studies. However, most studies implemented some form of a time delay procedure. Time delay procedures involve waiting a predetermined amount of time before delivering a prompt (e.g., Esbenschade & Rosales-Ruiz, 2001; Ostryn & Wolfe, 2011b; Shillingsburg et al., 2011). A second approach to prompt fading involved varying the length or intensity of the prompt. For example, a therapist might begin by providing a complete vocal model (e.g., “What is it?”), but then reduce

the length of the vocal model (“What. . .”) in conjunction with a time delay (e.g., Marion et al., 2011; Roy-Wskiaki et al., 2010; Sundberg et al., 2002). The participant is first expected to imitate the full model and then as the length of model decreases the participant fills in the missing parts of the question independently until the therapist no longer needs to model any portion of the question. The current literature provides evidence that echoic prompting and systematic prompt fading procedures, such as a time delay, are effective components of question-asking interventions.

In addition to improvements in question-asking skills, these interventions were also sometimes associated with gains in other related skills. For example, several studies demonstrated that after an individual had been taught to ask for the name of an unknown item they then used this name for expressive labeling. In other words, some individuals appeared to be able to learn new information from the answers to the questions they asked during intervention (e.g., Esbenschade & Rosales-Ruiz, 2001; Koegel et al., 1998; Taylor & Harris, 1995). Additionally, teaching individuals with ASD to ask questions appeared to reduce problem behavior in some cases. For example, Ingvarsson and Hollobaugh (2010) taught participants to mand for information by saying, “I don’t know. Please tell me,” when presented with a difficult task. Acquisition of this mand could be associated with a reduction in problem behavior, perhaps because the task thus became less difficult. Future research should investigate if mands for information have an effect on challenging behavior during work tasks.

The research reviewed here suggests that people with ASD can be taught to ask questions and that learning to ask questions might facilitate the acquisition of other communication skills and impact on other areas of adaptive behavior functioning. However, the studies so far have tended to involve participants with speech. Only one study (i.e., Ostryn & Wolfe, 2011a) used assistive technology (i.e., picture exchange communication system) to enable question-asking by nonspeaking participants. Given that AAC systems have been successful in supporting other communication and social skills for people with ASD (Ganz, Davis, Lund, Goodwyn, & Simpson, 2012; van der Meer & Rispoli, 2010), it seems likely that these might also enable nonspeaking participants to ask questions.

The most common questions taught in the reviewed studies were *what* and *where* questions. In typical language development, *what* and *where* questions appear before other question types (Bloom et al., 1982; Smith, 1933; Tyack & Ingram, 1977). This parallel is not surprising when taking into account that the reinforcement of early *what* and *where* questions is often more closely associated with a child’s environment, as *what* often yields names of new objects and *where* often reveals location of toys (Tyack & Ingram, 1977). In comparison, *why* questions develop later and may be more difficult to teach because the answer (often the only reinforcing consequence in the natural environment) involves information that may not have as much of an immediate benefit as *what* and *where* questions. Therefore, additional research aimed at teaching *why* also appears necessary.

The research base is also limited in terms of the diversity of listeners for the participants’ question-asking (e.g., teaching staff versus peers). Question-asking is ubiquitous in social conversation, it would seem to be necessary for research (a) to involve peers and unfamiliar listeners and (b) to include increased opportunities for social interaction with same-aged peers, decreased reliance on adult support in inclusive settings, and increased opportunities for generalization. Clearly, procedures designed to teach peer-directed questions are needed.

Although the acquisition outcomes were generally positive, generalization effects were somewhat limited. For example, while some studies reported positive results for generalization across instructional materials or activities (e.g., Betz et al., 2010; Endicott & Higbee, 2007; Marion et al., 2011), other studies reported mixed results (e.g., Charlop & Milstein, 1989; Esbenschade & Rosales-Ruiz, 2001; Shillingsburg et al., 2011). Further, although Betz et al. (2010) successfully taught three participants the *where* mand and it generalized across novel toys and novel settings, the mand failed to generalize to a natural behavior chain. This may be due to the lack of a verbal S^D (i.e., instructional cue), which was present during structured training sessions. Specifically, participants were taught to ask the question, “Where + [item name]?” after the therapist said, “Let’s play. Get [item name].” When probed in a natural behavior chain, wherein the verbal S^D was absent, the *where* question failed to generalize for all three participants. For example, in the “going for a walk outside” natural behavior chain, the participant was required to go to his backpack, retrieve his coat and hat, and line up at the door. This chain was interrupted by a missing hat, which would be the natural S^D (i.e., nonverbal cue) to elicit the question, “Where hat?” However, Betz et al. (2010) found that all three participants required training via an interrupted-behavior-chain procedure for multiple natural behavior chains (e.g., coloring, bowling, Play-Doh activity) before generalization to other natural behavior chains was achieved. These findings suggest the need for more research aimed at understanding and facilitating the generalization of these questions.

In conclusion, the findings of this review suggest that systematic instructional procedures (i.e., contrived EO, prompting, and reinforcement) have been effective in teaching individuals with ASD to ask questions. However, future research should aim to extend the evidence-base by addressing research questions related to question-asking via assistive technology, directing questions to peers and other diverse listeners, teaching *why* questions, and supporting the generalization and maintenance of question-asking.

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