FUNCTIONAL COMMUNICATION TRAINING TO DECREASE BIASED RESPONDING DURING ACADEMIC TASKS IN NON-VOCAL INDIVIDUALS WITH AUTISM SPECTRUM DISORDER

A DISSERTATION

SUBMITTED TO THE FACULTY

OF

THE GRADUATE SCHOOL OF APPLIED AND PROFESSIONAL PSYCHOLOGY

OF

RUTGERS,

THE STATE UNIVERSITY OF NEW JERSEY

BY

AUDREY VIRGINIA TORRICELLI

IN PARTIAL FULFILLMENT OF THE

REQUIREMENTS FOR THE DEGREE

OF

DOCTOR OF PSYCHOLOGY

NEW BRUNSWICK, NEW JERSEY AUGUST, 2020

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Abstract

Individuals with autism spectrum disorder (ASD) often demonstrate language and communication deficits; a subset of the population never develop functional spoken language. One way communication deficits manifest in children with ASD is an inability to seek help or assistance when needed. In academic settings, students may not know how to ask for help when confronted with novel stimuli, which can result in biased responding. Functional communication training (FCT), a method of teaching an appropriate communicative response to replace an inappropriate behavior, may be an effective method to reduce biased responding during academic tasks by teaching children with non-vocal ASD to request help utilizing augmentative and alternative communication (AAC) strategies when confronted with novel stimuli. The current study identified that biased responding emerged for a child with ASD who relies on a speech-generating AAC device when he was presented with novel stimuli. The study then utilized an FCT procedure to replace the biased responding with an appropriate response, "I don't know." The participant was able to learn the FCT response and distinguish between providing appropriate responses for mastered tasks and providing the FCT response for novel tasks during separate and mixed conditions. The participant was able to demonstrate maintenance and generalization to additional novel stimuli. Implications and limitations of the results are discussed.

Acknowledgements

To Kate Fiske Massey, thank you for your endless optimism, support, and encouragement throughout the process of developing, implementing, and writing this dissertation. I am so grateful to have you as a mentor throughout my graduate training, always modeling kindness, patience, and balance. To Kim Sloman, I am grateful for your tireless curiosity, guidance, and professionalism during my time at the Douglass Developmental Disabilities Center and on this project; your determination and follow-through has always inspired me.

To the staff and families at the Douglass Developmental Disabilities Center, thank you for not only helping out with my dissertation but also for always striving to be a model of compassion and quality care. Special thanks goes to Katie Kishel, Allie Hawkins, and Meredith Bamond, whose willingness and high professional standards helped immeasurably with study implementation and data management.

To my family, thank you for setting the example for how to build a life and career that is both challenging and deeply meaningful. I have made it to this point because of your unconditional love and support. To my husband, Nick DiBerardino, thank you for being by my side through every step of our lives together. Your boundless confidence, steadiness of character, and playful humor enabled me to truly enjoy the process. Finally, thank you to my cats for your daily reminder to occasionally take a nap, play a game, and eat treats.

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Introduction

Promoting Assistance-Seeking Behavior in Learners with ASD

Effectively seeking assistance can be difficult for neurotypical children and adults, let alone for children with developmental disabilities who have associated language and communication deficits. Yet failing to seek assistance can result in children with autism spectrum disorder (ASD) experiencing delays in learning, delays in relief of distress, reduced independence, and—at its worst—an increased risk of getting lost or injured. Help-seeking safety skills have been prioritized in research and practice, given the increased risks children with ASD have of elopement (Anderson et al., 2012), accidental injury (Lee, Harrington, Chang, & Conners, 2008), and becoming victims of crimes against property or personhood (Wilson & Brewer, 1992).

The majority of research investigating help-seeking behaviors has targeted safety skills like teaching children with ASD to seek assistance when lost (Bergstrom, Najdowski, & Tarbox, 2012; Hoch, Taylor, & Rodriguez, 2009; Taber, Alberto, Hughes, & Seltzer, 2002; Taber, Alberto, Seltzer, & Hughes, 2003; Taylor, Hughes, Richard, Hoch, & Coello, 2004). Other safety skills examined in children with developmental delays include abduction-prevention skills (Gunby, Carr, & LeBlanc, 2010) and appropriate responses to simulated injuries in others (Christensen, Lignugaris, Kraft, & Fiechtl, 1996). Most of these studies involved teaching children to respond to a cue indicating they were lost (e.g., a call from a cell phone), approaching a safe adult in the area (e.g., a cashier), and exchanging a card or engaging in vocal approximations for requesting assistance (e.g., "Help me"). Other research has focused on increasing assistance-seeking skills in the context of job skills training; for example, one study utilized graduated guidance, scripts, and script fading to teach adolescents in a work setting to approach an instructor, describe a work-related problem, and request specific assistance (Dotto-Fojut, Reeve, Townsend, & Progar, 2011).

A significant proportion of the literature in requesting assistance falls within academic settings. In this context, researchers and instructors frequently strive to foster initiation of communication by teaching children with ASD to mand for something like items, actions, or information. A mand, according to Cooper, Heron, and Heward (2007), is a “type of verbal operant in which a speaker asks for (or states, demands, implies, etc.) what he needs or want” (p. 540). Mands require the presence of an establishing operation (EO). An EO is “a motivating operation that establishes (increases) the effectiveness of some stimulus, object, or event as a reinforcer” (Cooper, Heron, & Heward, 2007, p. 6). Essentially, an individual needs motivation to request something by using a mand, and subsequent access to that thing (an item, action, or information) in turn reinforces the use of the mand. For example, a child may wish to eat a meal, but require a spoon to do so; the child’s motivation for the food increases their motivation for the spoon, which in turn increases their motivation to use a mand that will give them access to the spoon.

Manding and other help-seeking behaviors become more difficult for children who have significant impairments in speech and communication. Approximately 30% of people with ASD have little to no functional speech (Lord & Jones, 2012; Rose, Trembath, Keen, & Paynter, 2016). Only a few studies have investigated help-seeking behavior in children with low- or non-vocal communication, though ample research exists on the efficacy of alternative methods of communication for children with ASD who lack vocal speech. Numerous efforts have been made to develop forms of augmentative and alternative communication (AAC) for children diagnosed with ASD, including manual sign language (Bonvillian, Nelson, & Rhyne, 1981; Wilbur, 1985), the Picture Exchange Communication System (PECS; Bondy & Frost, 1994; Charlop-Christy, Carpenter, Le, Leblanc, & Kellet, 2002; Ganz & Simpson, 2004), and technology-based interventions like applications on portable tablet computers (Han, Kim, & Park, 2012; Lorah, Parnell, Whitby, & Hantula, 2015; Shane et al., 2012). Explicit instructional strategies are required to improve both general manding skills, as well as more specific or complex assistance-seeking communication skills, in low- or non-vocal children with ASD. Also, additional instructional strategies may be required to address unique challenges that arise with low- or non-vocal individuals who rely on AACs.

This introduction will review the research on how manding for information has been taught and researched as a means for increasing information-gathering communication in children with ASD. Then, a specific instructional strategy called functional communication training (FCT) will be introduced, which was developed and used to reduce specific problem behaviors by improving functional communication. Finally, this paper will explore how FCT may be used to address unique problem behaviors that are likely to arise during—and interfere with—academic instruction. Each section will additionally examine the extent to which this research has been applied to children with ASD who lack functional speech and who rely on AACs.

Manding for Information

Establishing operations. Manding for information is a unique target for manding in that the reinforcement is not tangible. The requesting-information behavior is under the control of an EO that ultimately results in reinforcement specific to that EO (Michael, 1988). For example, a hungry child may ask where snacks are stored; hunger acts as the EO for which the information provides the possibility of reinforcement by grabbing a snack. Without hunger as a motivator, the information on where snacks are stored is less meaningful and therefore much less likely to be reinforced and remembered.

Question-asking, in general, is an important social method of gathering information to broaden and deepen one's understanding of a particular topic. Asking questions is a way of demonstrating curiosity about the world, and questions allow learners to more effectively complete tasks, become exposed to more language that will increase verbal repertoire and overall language development, and initiate more social interactions (Shillingsburg, Valentino, Bowen, Bradley, & Zavatkay, 2011). Unfortunately, without inherent social motivators, children with ASD are much less likely to seek information for information's sake. Individuals with ASD who have social and communication deficits have a significant barrier to engaging in any question-asking, which can impede meaningful learning and engagement in formal and informal settings. Mands for information, therefore, are a functional means for children to access reinforcing assistance or knowledge within an academic environment which may additionally further improve opportunities for learning and socialization.

The key barrier to teaching manding for information to individuals with ASD is that information itself may not have a very high reinforcing value. In general manding research and practice, instructors increase manding through instructional methods like developing an EO, modeling the desired response, prompting the response and fading that prompt out over time, and providing the desired reinforcers. We see clear examples of this approach in the literature on manding for information. For example, Williams, Donley, and Keller (2000) used modeling and prompt fading to effectively teach children with ASD as ask several questions, including "What's that?" "Can I see it?" and "Can I have it?" to access "attractive" objects hidden in boxes. Similarly, Twardosz and Baer (1973) used modeling and reinforcement to teach two children with intellectual disabilities to ask a question—“What letter?”— when presented with the blank side of alphabet cards to teach them to acquire the missing information from the instructor, for which they were reinforced with praise and token reinforcement to access candy.

Hung (1977) taught four children with ASD and minimal vocal communicative abilities to ask spontaneous questions like, “What is a glass for?” (A: drinking) and “What is he doing?” (A: running) while at summer camp. Despite succeeding in teaching children the response in a classroom-like setting, Hung found that spontaneous question-asking did not occur outside of session, indicating that the information received was not reinforcing in and of itself. Question-asking in novel settings increased once token reinforcement (used to trade in for edibles, activities, and meals) was introduced. Hung also found that the participants needed additional modeling for correct answers before they could demonstrate that they learned the answers to their questions; this means that the children learned to ask the question, but were not able to use the information provided in a meaningful way.

Functional use of acquired information. This issue of teaching both manding for information and demonstrating acquisition of the learned information was investigated by Taylor and Harris (1995) in a series of three studies. The researchers taught three children diagnosed with ASD who had not previously been observed to ask questions to mand for information and then demonstrate expressive knowledge of the information provided in response to their questions. In the first study, following baseline, the teacher presented three known pictures and one unknown picture in an array on the table; the teacher prompted the student by stating, “Tell me what you see on the table.” Students pointed to each picture from left to right and stated the name of the item. When they reached the novel stimulus, the instructor modeled saying “What’s that?” with a 0-s time delay. Student repetition of the question resulted in praise, the name of the picture, and reinforcement. The prompt was then gradually faded to a 10-s delay when the mastery criterion was reached. Generalization probes were introduced in a different setting with a different instructor and with three-dimensional objects. All three participants in Study 1 demonstrated acquisition of the skill and were successfully able to generalize the question-asking to the new setting, instructor, and object. Anecdotal reports indicated that all of the children asked the question in natural contexts.

In their second study, Taylor and Harris investigated whether the students were able to successfully learn the labels using the same procedure as in their first study, with additional probes included to assess expressive and receptive identification of the stimuli. All children were able to acquire receptive labels to 100% mastery criterion, and two of the three students acquired expressive labels to 100% mastery. This study demonstrated that the question “What’s that?” taught in Study 1 was an effective means of actual information-gathering, rather than merely becoming a rote response.

The third and final study conducted by Taylor and Harris investigated the generalization of the “What’s that?” response to actual novel objects encountered during a walk within the school building. When encountering one of 10 novel objects in the school building, the instructors initially presented a 0-s time delay model prompt for the desired response. Student repetition of the question resulted in reinforcement, and once the student reached mastery criterion, the instructor systematically faded the model prompt to a10-s time delay. One student generalized mastery of the “What’s that?” response to novel stimuli in the building during baseline; the other two achieved mastery within 7 to 16 sessions. Additionally, all three students demonstrated further generalization by pointing to stimuli *not* placed by the investigators and asking, “What’s that?” These promising results require further research to assess generalization outside of the school context, generalization to informal activities, response generalization to new “wh-” questions, and whether or not the learners can ask questions about non-visual stimuli.

As has already been discussed, contriving EOs for information alone can be difficult; most studies that aim to foster manding for information focus on teaching children ASD to mand for hidden or difficult to access preferred items to easily establish an EO for the mand. For example, Betz, Higbee, and Pollard (2010) taught children with ASD to ask, “Where + (item),” to access preferred items like toys and puzzles. Sundberg, Loeb, Hale, and Eigenheer (2002) taught children with ASD to ask “Where?” and “Who has it?” after hiding reinforcing and neutral items, and found it was easier to teach the skill to find reinforcing items than neutral items, but that ultimately all items were teachable and generalizable. Endicott and Higbee (2007) similarly taught children with ASD to access both high- and low-motivating items by instructing a participant to “Get (item).” Only by the child asking “Where (item)?” or, in a later experiment, “Who has it?” would the instructor inform the child how to access the item (e.g., “It’s in your backpack”). Relatedly, Shillingsburg and Valentino (2011) used modeling to successfully teach a child with ASD to ask an infrequently trained question, “How?” to access information needed to complete activities like turning his sound on during a computer game, pressing the “talk” button to use a walkie talkie, and unlocking the gate to use the swing. This study was followed up by Lechago, Howell, Caccavale, and Peterson (2013), who were able to teach children with ASD the questions “How do I?” and “How many?” to access preferred reinforcers using prompting and behavior chains.

Shillingsburg and colleagues (2011) added to the literature by teaching two children with ASD to ask the questions “When?,” “Who?,” “Where?,” and “Which?” to gain information to access preferred items or activities. The researchers utilized EO manipulations, echoic prompts, and reinforcement to successfully teach the participants to ask all questions, and additionally found that general response topographies (e.g., “Who has it?”) were more effective at promoting generalization of the effective use of questions than were specific response topographies (e.g., “Who has my train?”). Notably, Shillingsburg and colleagues chose to define the target skill as “requests for information” rather than “mands for information” as the researchers were unable to determine if the participants’ behaviors were under the control of stimuli beyond the EO they sought to establish.

Differential use of manding. An important element of effective manding for information is to establish differential operations for a student’s use of manding. That is, learners should know when to ask for information (with an EO), as well as when it would be inappropriate to ask for information (in the presence of an abolishing operation, AO, or a motivating operation that decreases the effectiveness of an item—or in this case, information—as a reinforcer). Ingvarsson and Hollobaugh (2010) asked learners with ASD to mand for answers to instructor’s questions by saying, “I don’t know, please tell me” (IDKPTM). The researchers asked questions for which the participants knew the correct response, as well as questions for which the participants did not know the correct response. In the researchers’ terms, “known” and “unknown” questions acted as abolishing and establishing operations, respectively, for the IDKPTM response. The researchers found that the response taught in the study for unknown questions, IDKPTM, generalized appropriately to new questions as it was only used in response to unknown questions.

Similarly, Shillingsburg, Bowen, Valentino, and Pierce (2014) effectively taught children with ASD to ask “Which?” for help finding a preferred item hidden under one of nine opaque colored cups under an EO condition; the AO condition involved the instructor telling the student where the item was hidden at the outset of the task. The researchers also taught the same students to ask “Who?” when one of several therapists hid a preferred item. The students in this study learned to effectively mand for information during the EO condition and not during an AO condition where they were already provided the information on where to find missing items. Additionally, once provided the information about where the item could be found, the participants approached the correct cup or staff during both conditions to acquire their preferred items, demonstrating that their mands proved functional by enabling them to access and utilize information needed to acquired preferred items.

Teaching manding to low- or non-vocal learners. While research teaching children with ASD to mand for information naturally involves participants with limited vocal repertoires, only three studies to date have investigated the efficacy of teaching children to mand for information using a speech-generating device (SGD). The first was Carnett and Ingvarsson’s (2016) study which replicated Ingvarsson and Hollobaugh’s (2010) study discussed in the previous section. The sole participant was a boy with ASD who used an SGD. Instructors presented the participant with unknown questions across three unknown sets, such as the functions of common objects (e.g., “What do you do with a bike?”). The instructors taught the participant to mand for answers to their questions using the IDKPTM phrase pulled from Ingvarsson and Hollobaugh’s prior study. Unknown sets were counterbalanced against one set of inquiries for known questions (e.g., tacting common objects). Further, the researchers investigated the acquisition of intraverbals by evaluating whether the participant learned the answers to the questions. During training, participants were presented with a question, and then were immediately prompted (0-s time delay) by a vocal and textual model prompt of IDKPTM via instructor vocal speech and the presentation of a printed card with a textual prompt of IDKPTM. When participants imitated the IDKPTM, the instructor then provided the answer to the presented question (e.g., “You ride a bike”). Throughout the study, independent, unprompted responses providing correct answers resulted in enthusiastic praise from the instructor. After two consecutive trials of correct responding, a 5-s time delay was introduced between the question and the instructor’s IDKPTM prompt. The researchers found that the IDKPTM did not generalize to the third unknown set, so training occurred until some generalization was demonstrated. Ultimately, this study was able to demonstrate that a child with ASD who utilized an SGD was able to learn to mand for information, and, as a result of his mands, learn the answers to questions, demonstrating intraverbal learning.

Shillingsburg and colleagues’ (2014) study on manding for information was replicated and extended by Shillingsburg, Marya, Bartlett, and Thompson (2019), by teaching three children with ASD to mand for information (“Who?” and “Which ___?”) using an SGD. The researchers established an EO for the information to access preferred items. Results indicated that most participants were easily able to effectively discriminate between when to use “Who?” and when to use “Which?” questions, and participants effectively manded for information during EO trials but never during AO trials when the information was already provided, indicating good functional control by the EO.

The final, and most recent, study to investigate manding for information in children who utilize AACs was conducted by Carnett, Ingvarsson, Bravo, and Sigafoos (2019), who utilized an SGD to teach children to mand for a missing item’s location (“Where?”) using a least-to-most prompting hierarchy during a planned interruption of a behavior chain, where the researchers hid a key element from a game (e.g., marbles or a spinner). They also investigated the participants’ ability to demonstrate persistence and generalize their mands to novel communication partners when the first partner did not provide the desired reinforcement, and found that one participant was able to persist and generalize quickly, whereas the other participant required additional training to generalize his mand for information across partners.

Teaching manding is one step towards teaching children with ASD to use language to access what they want. Yet regardless of vocal or communicative abilities, children sometimes learn to get what they want through non-vocal means. For example, a learner may learn to escape challenging academic tasks by acting aggressively. A more subtle academic-interfering behavior occurs when a student learns to access intermittent reinforcement for difficult tasks in low-effort ways, such as by always choosing the same item or the item in the same position each time the task is presented. These stimulus or positional biases, respectively, are problematic and interfere with academic progress, but providing learners with a means of asking for help during difficult or frustrating tasks may offset the development of these biases.

Functional Communication Training

FCT for challenging behaviors. FCT is an established and effective means of teaching learners with ASD to appropriately communicate their needs utilizing vocal or non-vocal language. FCT was developed by Carr and Durand in 1985 for children with ASD to reduce attention- and escape-maintained problem behaviors like aggression, tantrums, self-injury, oppositionality, and being out of their seats during academic instruction. The researchers replaced the attention-maintained problem behaviors by teaching students to ask, “Am I doing good work?” during easy tasks with high correct response rates, which resulted in praise and attention. Similarly, they taught students demonstrating escape-maintained behaviors to say “I don’t understand” during difficult tasks that typically had high error rates, which led to instructor assistance. These communicative responses were effective in providing students with appropriate responses that allowed them to contact the same reinforcement contingencies as their problem behaviors, which resulted in a reduction of those problem behaviors.

In the largest study investigating the efficacy of FCT to reduce problem behaviors, Hagopian, Fisher, Sullivan, Acquisto, and LeBlanc (1998) implemented FCT for 21 inpatients with developmental or cognitive delays. Their study investigated both the presence and absence of extinction and punishment, and targeted a range of behaviors including aggression, self-injury, property destruction, elopement, and pica. Communication responses consisted of either verbal, gestural, or picture exchange methods based on the abilities of the individual, and each consisted of three discrete steps to be trained. Although the researchers did not find FCT alone to be effective for any of the participants, they found a 90% reduction in 23 of 27 problem behaviors when FCT was combined with extinction or punishment. FCT with extinction was effective with only 11 of 25 applications, whereas FCT with punishment was effective in all applications.

Best practice procedures. According to Mancil and Boman (2010), FCT involves three steps. First, conduct a functional assessment on a target problem behavior or set of behaviors. Then, identify an alternative communicative response (vocal speech, gestures, pictures, or other AACs like an SGD) that is functionally equivalent to the problem behavior. Finally, develop a treatment plan, typically using discrete trial procedures, to teach the child the target communicative response while placing the problem behavior on extinction. Ten additional important elements of the treatment plan include having a data-collection plan; reviewing data; capitalizing on natural opportunities in the environment; planning for generalization across people, environments, and stimuli; prompting; reinforcement; placing the challenging behavior on extinction; shaping the desired behavior; fading prompts; and introducing time and distance delays.

Tiger, Hanley, and Bruzek (2008) also developed a set of guidelines to effectively implement functional communication training based on results of decades of research in the field. These guidelines consider reinforcement and reinforcement thinning, response topography, where to implement FCT and by whom, and how to teach FCT. Specifically, reinforcement for the identified functional response should match reinforcement for the target problem behavior. The functional response would ideally be socially recognizable, be already in the child's repertoire, and require less effort than the problem behavior but can be shaped into higher-effort responses that are more likely to contact natural reinforcement (e.g., requesting "May I have the car, please?" instead of just stating "Car"). Additionally, generalization should be considered, including whether to initially teach the response in restricted vs. community settings, as well as training the target response across multiple instructors, environments, and stimuli.

Tiger and colleagues (2008) also address pros and cons for using natural vs. contrived EOs as well as least-to-most vs. most-to-least prompting strategies. Additionally, consequences for the problem behaviors should be considered; if reinforcement continues for the problem behavior, then reinforcement for the alternative response should be longer, higher, and at a greater rate. Extinction has some support in reducing problem behaviors during FCT, and if extinction is insufficient, then punishment procedures are proven to be effective at reducing problem behaviors and enhancing FCT outcomes. Finally, instructors should consider eventually thinning reinforcement for communicative responses to reflect natural contingencies and enhance generalization and maintenance. Thinning can be done with a time delay, providing a discriminative stimulus that indicates the presence or absence of reinforcement for the communicative response, or providing preferred or competing items to children to help them tolerate any delay to reinforcement. To address the gap in FCT research on generalization and maintenance of the FCT response identified by Mancil (2006), Hagopian, Boelter, and Jarmolowicz (2011) found that a functional response may weaken or extinguish if it occurs at rates too high to be practically reinforced. Therefore, thinning the reinforcement of an appropriate response is a means of preparing the student for generalization and maintenance. Four types of schedule thinning include delay schedules, chain schedules, multiple schedules, and response restriction (Hagopian et al, 2011).

Each step of the best practices just described can, and should, be applicable to individuals with low- or non-vocal speech, from initial functional assessment procedures through generalization and fading strategies. The following is a review of how FCT has been used to specifically target children with non-vocal communication repertoires, including some communication considerations specific to this population.

FCT for low- or non-vocal learners. Fortunately, much of the research investigating functional communication training has been implemented for children with various communication repertoires, and findings suggest FCT can be very effective to reduce a wide range of problem behaviors regardless of communication modality. Many studies incorporate a variety of communicative responses according to the needs of their participants, as with Hagopian and colleagues' (1998) study already discussed, where the researchers utilized vocal, gestural, and picture exchange modes of communication. Durand (1993) conducted an FCT study for three participants who required AACs, and found AACs to be efficacious for reducing challenging behaviors like aggression, self-injury, and tantrums by teaching the participants to request social attention or breaks. Durand also found that the students displayed more positive facial expressions post-FCT training compared to pre-training, suggesting less distress using the FCT response in place of problem behaviors. Durand conducted a similar study in 1999, finding that FCT using AACs in school was effective at teaching functional responses and reducing problem behaviors. The functional responses were additionally able to be generalized to untrained adult community members during community visits (e.g., at the candy store, local shopping mall, or movie theater). A meta-analysis of AACs in schools (Walker, Lyon, Loman, & Sennott, 2018) found that FCTs that involved aided or unaided AACs both improved the use of those AACs in addition to reducing problem behaviors across a range of school settings, with slightly greater effects for female students, students demonstrating less intense problem behaviors, and students in more inclusive school settings.

Another study was conducted by Wacker and colleagues in 2005, where researches taught 25 parents to conduct functional analyses, and taught 23 of those parents to incorporate FCT in their homes. Although the authors did not clearly state what percentage of children utilized AACs, they noted that functional communication responses included verbal requests, signed requests, touching a word or picture card, or using a microswitch communication device. Wacker et al. noted that the parents found the intervention to be both acceptable and effective.

Some research has focused on comparing the efficacy of different communication modalities during FCT. For example, one meta-analysis compared effect sizes of vocal communication, unaided AACs like sign language and gestures, and aided AACs like speech-generating device or picture cards (Heath, Ganz, Parker, Burke, & Ninci, 2015). They found that vocal communication had the greatest effect sizes, indicating that it is likely the most effective form of communication; the second-largest effect sizes was for aided AACs, with the lowest effect sizes for unaided AACs (they note, however, that cognitive ability may be a moderating variable). Proficiency in a communication modality and response effort are, of course, important variables to consider when deciding which communication modality to utilize. Ringdahl and colleagues (2009) identified “high proficiency” and “low proficiency” mand topographies for children with ASD based on the degree of prompting required, and found better FCT outcomes for high-proficiency responses over low-proficiency responses. Presumably, those who prefer vocal responses find that they require less response effort; this has been confirmed by Harding et al. (2009), who taught children FCT through vocal manding, manual signing, or touching a picture/word card with or without a microswitch recording device. The researchers found that all three participants ultimately demonstrated a preference for vocal manding. However, if a learner is unable to use vocal speech functionally and effectively, then research highlights the importance of considering aided AACs and high-proficiency repertoires as communication modalities that are most likely to be effective when teaching a functional communication response.

Over the past three decades, FCT has been used to improve appropriate behaviors in children and adults, and has effectively reduced a range of problem behaviors including aggression, self-injury, motor and vocal disruptions, bizarre vocalizations, stereotypy, inappropriate sexual behavior, self-restraint, and inappropriate communicative behaviors (Tiger, et al., 2008). Many of these behaviors are disruptive to the learning process, in addition to being socially inappropriate. Yet there a variety of less disruptive behaviors that interfere with the learning process that may be effectively targeted by functional communication training as well, including behaviors like echolalia, incorrect responding, and biased responding.

FCT in Academic Settings

Escape from academic tasks. In their 2008 review of FCT research, Tiger et al. found that problem behaviors functioned as an escape from demands in 43% of cases, greater than other functions investigated, including attention (32%), tangibles (29%), access to other events like restraint (3%), or escape from other events like loud noises or social interaction (4%). Indeed, Carr and Durand's (1985) seminal study was conducted specifically to address escape-maintained behaviors that occurred during challenging academic tasks, in addition to attention-maintained problem behaviors during easy academic tasks. Durand and Carr (1991) similarly found FCT to be effective for three students with ASD who engaged in problem behaviors to escape from academic tasks. These problem behaviors included crying, screaming, falling to the floor, pinching and slapping others, and dangerous self-injurious behaviors that sometimes required medical attention, like head-banging and face-slapping. Durand and Carr found that the functional communicative response was effective at reducing problem behaviors, and the appropriate response generalized across tasks, settings, and teachers, and were maintained from 18 to 24 months following training.

It is unsurprising that previous researchers have focused their efforts on reducing and replacing distressing or dangerous behaviors that function to escape from academic tasks. Some students who find novel and challenging tasks aversive may also be engaging in other, less-obvious behaviors to reduce effort while still accessing reinforcement associated with academic instruction. One such behavior may be biased responding.

Faulty stimulus control and biased responding. Many learners with ASD are presented with novel materials or tasks during academic instruction, and learning primarily takes place via behavior analytic antecedent (e.g., modeling) or consequent (e.g., the presentation or withholding of reinforcement) manipulation. Because children with ASD may not be able to communicate confusion or mand for information about the task in front of them, they may be more prone to developing faulty stimulus control. Faulty stimulus control occurs when a "target behavior comes under the restricted control of an irrelevant antecedent stimulus" (Cooper et al., 2007, p.

630). This means that a learner selects a particular response to a task on some feature not relevant to the target learning. For example, during a novel receptive identification task, a learner might be reinforced for selecting the rightmost item in an array. Rather than learning they are to select “bicycle” out of other vehicles, their behavior may instead be controlled by the intermittent reinforcement of a rightmost selection as the instructor rotates the target items across positions. Selecting a single position that is intermittently reinforced likely requires far less response effort than learning the relevant stimulus cues required to effectively identify novel targets. This is one means by which a position bias may develop, and position biases can be difficult to undo, in part due to the intermittent reinforcement inherent in their development.

Most studies addressing biased responding were able to reduce the bias by either manipulating reinforcement quality, quantity, magnitude, immediacy, or rate (Galloway, 1967; Neef, Mace, & Shade, 1993; Neef, Mace, Shea, & Shade, 1992; Neef, Shade, & Miller, 1994), or by implementing correction procedures that reduced the reinforcing qualities of biased responding. The latter had only been conducted on pigeons (Kangas & Branch, 2008) until Bourret, Iwata, Harper, and North (2012) incorporated both reinforcement manipulations and correction procedures in their study investigating strategies for reducing position bias in five children and adults with ASD or other developmental disabilities. The researchers utilized reinforcers as stimuli; they first manipulated reinforcer quality by pairing identified non-preferred items with preferred items, with items presented on both the right and left sides during trials. Three children were able to break their side bias to select the more preferred reinforcer. Two learners who continued to demonstrate a side bias then went through magnitude training: the researchers presented five times the number of preferred reinforcers on one side compared to only one reinforcer on the other. Magnitude training was not sufficient to eliminate the bias demonstrated by two of the participants, so an additional error correction procedure was added to the magnitude bias. The error correction procedure involved blocking selection of the low-magnitude option, with manual guidance to select the high-magnitude option. Manual guidance did not, however, result in access to the items. The combined procedure proved sufficient to eliminate the position bias in two individuals, although the error-correction procedure alone is confounded with the magnitude training. Additionally, using preferred items as stimuli is problematic in that there are technically no “wrong” selections, and only two selections were presented at a time; use with discrimination tasks utilizing three or more items remains unclear. Perhaps most notably, the implication that biases can persist to such a degree as to interfere with access to many preferred reinforcers highlights the highly persistent nature of biases for some learners.

One issue with many of these strategies is that they are reactive strategies in that they address issues of position biases after they develop. Antecedent strategies may be more effective at preventing or eliminating position biases because the learner does not engage in the behavior in the first place. Green (2001) has highlighted a number of instructional errors that can result in faulty stimulus control, and offers plenty of antecedent solutions to prevent faulty stimulus control from developing. For example, if the stimuli in the instructional array are not balanced across positions equally, the learner may access more frequent reinforcement by selecting a specific stimulus position over relevant instructional stimulus features. Additionally, frequent introduction of novel stimuli “distractors” in the stimulus array may shape learners to allocate greater or less attention to the novel stimuli rather than learn the appropriate conditional discriminations. Issues can arise when instructors use simple-discrimination methods to teach “in isolation” (Green, 2001, p. 77), such as when a spoon is presented as the target for each trial, with only a picture of a spoon in the array before doing the same for fork and then knife before mixing all three. In this way, targets are taught sequentially rather than simultaneously, and the learner does not learn to discriminate relevant features of each target or of the comparison stimuli. Teaching in isolation first teaches individuals simple discrimination rather than conditional discrimination and makes it harder for the learner to then perform conditional discrimination when stimuli are mixed. These simple discrimination trials may teach learners to not attend to sample stimuli at all, even when it is present, to determine how best to respond during the tasks.

Green’s (2001) recommendations for the most effective instructional setup to reduce faulty stimulus control includes presenting a different stimulus each trial while keeping the same comparisons included; having at least three comparisons on every trial; unsystematically presenting each sample equally often within a session while varying the position of the target stimulus unsystematically; requiring learners to make an observing response (e.g., pointing to the sample stimulus); rearranging comparison stimuli out of sight; using errorless learning procedures; and teaching learners foundational skills for match-to-sample tasks like sitting quietly between trials, orienting to stimuli, scanning, and making single responses.

Grow, Carr, Kodak, Jostad, and Kisamore (2011) compared simple-conditional (in which simple conditions are taught in isolation) and conditional-only (in which the conditional discriminations are trained from the onset) methods for teaching receptive language to three children diagnosed with ASD. The researchers found the conditional-only method to be more effective at teaching discrimination. During the simple-conditional task, error patterns emerged, like a strong right bias. The bias was eliminated by implementing most-to-least prompting. The researchers concluded that formatting an array with only two stimuli to discriminate increased the potential for faulty stimulus control.

Some of Green's recommendations may be more difficult to implement in a busy classroom environment than others. Even when Green's recommendations are followed, learners' responses may still fall under faulty stimulus control. While response biases likely develop due to contingences that reinforce the selection of a particular position or stimulus, an additional consideration is that many learners with (and without) ASD do not know how to effectively ask for instructor assistance or help when they are presented with novel stimuli. They therefore make guesses and contact consequences that either reinforce or punish their responses. If a learner is able to effectively seek assistance, then their instructor can direct the learner towards the appropriate stimulus discriminations to effectively facilitate learning. Using FCT can assist the learner in demonstrating appropriate behavior (requesting help) in place of an inappropriate behavior (biased responding) when presented with novel instructional stimuli.

"I don't know" as a functional communication response. Ingvarsson and colleagues have discussed how children unable to answer questions accurately or appropriately were at risk of experiencing a lower quality and quantity of adult interactions and may experience lower peer acceptance (Ingvarsson, Tiger, Hanley, & Stephenson, 2007). Some researchers have successfully utilized FCT to address inappropriate responses in the form of echolalic responding that occurred when presented with novel questions or stimuli by providing a more appropriate generalized vocal response of "I don't know" (IDK; Schreibman & Carr, 1978; Tucker, O'Dell, & Suib, 1978). IDK is an appropriate response to unknown stimuli, however, more complex responses may help children access assistance that will recruit help and promote more learning opportunities. When teaching children to respond to intraverbal responses, instructors can either

(1) teach the correct responses to questions, (2) teach responses that can generalize to a wide range of questions, or (3) teach children to recruit the answers themselves (Ingvarsson et al., 2007). A number of the studies presented earlier that investigated strategies to promote manding for information (Hung, 1977; Taylor & Harris, 1995; Twardosz & Baer, 1973; Williams et al., 2000) are examples of the third approach, teaching children to recruit answers.

Ingvarsson and colleagues (2007) wanted to investigate the impact of teaching young children with and without developmental disabilities to respond with IDK (a generalized response) and later, IDKPTM (a recruiting response), when presented with a question whose response they did not know the answer to. The researchers wanted to know if appropriate generalization of the mand occurred to known and unknown questions, as well as if the children were able to acquire the correct responses to the unknown questions. The participants were children selected because they engaged in more inappropriate responses to questions than their peers; for example, participants responded to questions with profanity, vocal stereotypy, delayed echolalia, or unrelated comments about the immediate environment. By teaching their participants to provide a functional and appropriate response when presented with an unknown question, researchers could both increase the children's learning while reducing their problematic responses. Questions ranged from person questions ("What is your name?") to general knowledge ("How many days are in a week?") to preacademic skills ("How much is a nickel?"). The study utilized a multiple baseline across responses design: After baseline, teachers taught the students the IDK response using progressive prompt delay, and later followed with training an IDKPTM response. One child required direct teaching of correct answers as he did not acquire any correct answers to the questions after training IDK and IDKPTM. Appropriate and inappropriate generalization to other known and unknown questions was evaluated as well.

The researchers found that all of the children were able to acquire the IDK response and were able to generalize across novel questions and a different teacher. However, they also found that three of the four participants engaged in inappropriate generalization to known questions. The IDKPTM response was also acquired by all the students and generalized to novel questions. Yet only one student demonstrated notable increases in providing correct answers to the novel questions. When access to toys was restricted for incorrect answers, the children provided more correct responses, indicating additional contingencies are likely required to promote learning.

One concern from the researchers' findings is that the IDK responses generalized to known questions. One possible reason for this is that IDK response could be a less effortful response than generating the correct answer. Additionally, reinforcement following the IDK response was likely more reliable than reinforcement for the correct response during the training phases (some participants gave the "correct" response but for the wrong question). It is also possible that IDK is less effortful than IDKPTM, therefore potentially limiting the response meant to seek information. The IDKPTM response was only more effective at increasing learning when reinforcement contingencies were in place to favor learning. That is, when students were only required the provide the response and repeat the correct answers, learning did not occur. One benefit of generalized responses is that they can at least reduce inappropriate responding and therefore allow individuals to contact more social reinforcement from adults and peers. Also, when in place, these help-seeking responses can foster more learning, assisting in the educational process.

As has already been introduced in the "Manding for Information" section, Ingvarsson and Hollobaugh (2010) conducted a similar study to Invargsson and colleagues (2007), this time using echoic prompting and prompt delay to teach four children with ASD to respond to unfamiliar questions with IDKPTM. All four of the children acquired the response, and two of the children acquired correct answers to the questions. A third child learned the correct answers when tangible reinforcement was provided, and a fourth learned the correct answers when direct prompting of the correct answers was introduced. The IDKPTM response also generalized to other unknown questions for three of the participants, and generalization for all participants occurred when additional training was provided. Both of Ingvarsson and colleagues' studies (2007; 2010) demonstrate that teaching a generalized response is easier than a recruiting response, but learning the answers to instructor questions was far less likely to occur during generalized responding. When recruiting responses were paired with additional reinforcement and/or prompting strategies, learning the correct answers to instructor questions increased substantially.

"I don't know" as a functional communication response to reduce biased responding. Only one study to date has investigated FCT of IDK to reduce biased responding. In a 2017 pilot study, Torricelli, Isenhower, Delmolino, Lauderdale-Littin, and Sloman collected preliminary data on the use of functional communication training to reduce position biases during academic tasks in two children with ASD who utilize vocal communication. Using an ABAB reversal design, two participants—a 15-year-old female and a 12-year-old male—were presented with 150 black-and-white novel stimuli drawn from Dube, Iennaco, and McIlvane (1993). Each image was paired with a nonsense syllable. A stimulus cue, a blue card with the words IDK printed on it, was present during conditions with novel items. Additionally, participants were presented with mastered stimuli to encourage discrimination training between responses required for mastered vs. novel stimuli, similar to the methods used subsequently in DeQuinzio, Taylor, and Tomasi (2018). Preferred items and edibles were selected by the student during a brief multiple stimulus without replacement (MSWO) preference assessment (DeLeon & Iwata, 1996) prior to each session.

During baseline, the instructor presented a receptive identification task: Three stimuli were placed in a linear array in front of the student and they were asked, “Where is ___?” The initial baseline involved differential reinforcement for correct responding across novel and mastered trials to mimic typical classroom procedures where biased responding sometimes contacts reinforcement. When position biases were observed during baseline with novel stimuli, a training procedure was implemented to teach the IDK response during tasks with novel stimuli.

During the training procedure, upon presentation of the novel stimuli as in baseline, instructors provided an immediate echoic prompt of IDK and presentation of the blue visual cue card. Correct responses—saying IDK—contacted immediate social and tangible reinforcement. Incorrect responses were followed by continued re-presentation of the prompt until the participant correctly stated “IDK.” Upon mastery of the 0-s time delay, a 5-s time delay was introduced. Upon mastery of the 5 s time delay, learners entered into the FCT treatment phase.

During the FCT phase, mastered and novel stimuli were presented in alternating blocks; current answers for mastered stimuli were reinforced, and the IDK response was reinforced for novel stimuli. One participant had two additional conditions: shorter blocks of 6 trials (instead of 12), and then mixed blocks of mastered and novel stimuli. Introducing a mixed condition demonstrated the skill being used in real time, where the participant was required to rapidly discriminate between the novel and mastered items and provide the appropriate response to each.

The results of the study showed that both participants developed a position bias during baseline, with no help-seeking or IDK responses demonstrated. Both participants quickly acquired the IDK response, and both demonstrated a re-emergence of a position bias during the return to baseline. The participants were able to quickly re-acquire the functional response, which was then maintained at a one-week follow-up. Neither participant demonstrated a position bias with the mastered items, responding to mastered items with near-100% accuracy. The participant who also completed the 6-block phase and mixed phase was able to quickly demonstrate mastery with mixed mastered and novel trials. These results demonstrate that the functional communication intervention was effective at increasing an appropriate IDK response and reducing biased responding during tasks with novel stimuli. The results also show that biased responding was not present during mastered trials, which supports the hypothesis that biased responding likely develops when learners are confronted with novel stimuli. Training the IDK response to independence was fairly quick and was generalizable to a mixed block of novel and mastered trials as well.

There are several limitations to this preliminary data. The first is that the instructors presented blocks of trials, meaning the learners did not need to attend to the stimuli after the first trial or two; the mixed condition was introduced to counteract this limitation. Additionally, the novel stimuli did not resemble stimuli learners are likely to encounter in their classroom or other settings. Providing non-representative stimuli enabled the researchers to control for learning, so that the novel material remained novel throughout the study, but further research should seek to utilize real, ecologically valid stimuli that the learners are unable to correctly identify. Finally, this study required the participants to provide a vocal response that allowed for differential reinforcement of alternative behavior (DRA). Developing an FCT response that instead functioned as a differential reinforcement of an incompatible behavior (DRI), where the learner touches a response card instead of one of the novel stimuli, would prevent the learner from both responding with IDK while simultaneously selecting one of the stimuli (although this was not an observed issue within this study). Developing a DRI can easily be addressed during training for low- or non-vocal children who utilize AACs, as their functional response will inevitably require a response on their AAC incompatible with receptively selecting an item. Consistent with this last point, there are elements in Torricelli et al's (2017) study that may require modifications to be effective with children with limited vocal repertoires. While this study was able to demonstrate that vocal learners with ASD can develop position biases during novel tasks, as well as show how those biases can be successfully offset by an FCT procedure, we don't know how this procedure will work with low- or non-vocal individuals with ASD.

Conclusion and Hypothesis

The results of current review demonstrate a body of research that supports the instruction of help-seeking behavior in individuals with ASD. One area in which children may need help but are not accessing it is during academic instruction of novel stimuli. Children who do not know what they are required to do are more likely to make guesses, and are at risk of developing faulty stimulus control like position or stimulus biases. FCT has been a well-researched method of reducing problem behaviors in children with ASD during academic tasks. If faulty stimulus control like biased responding is considered a "problem behavior," then FCT can be used to train an appropriate help-seeking response that is likely to reduce the learner's biased responding. Limited research exists on using FCT to teach help-seeking behavior in children who rely on AAC devices. Preliminary research supports the use of teaching a functional communication response to vocal children with ASD who demonstrate biased responding during novel tasks. We hypothesize that low- or non-vocal children with ASD also develop biases during novel tasks, and that a similar functional communication procedure to teach the response IDK using speech-generating devices can be used to reduce biased responding and increase help-seeking responses in this population.

Methods

Participants and Setting

Recruitment for the study occurred at a university-affiliated school specializing in applied behavior analytic interventions for children with ASD. Inclusion criteria for participants required that they be students at the center diagnosed with ASD. Potential participants must have used an SGD device as their primary communication modality, and were required to possess the ability to independently label items with their device. Additionally, potential participants were required to demonstrate prerequisite skills necessary for discrete trial instruction (e.g., sitting, attention to stimuli, selecting stimuli) and an acquired repertoire of over 20 mastered receptive identification labels. Using these criteria, two participants were identified and consent forms were sent to parents. Consent was given for the participation of one student.

The participant, a 12-year-old boy named Mark, participated in this study. Mark had received a previous diagnosis of ASD and relied upon his speech-generating AAC device, an iPad with the Proloquo2Go app installed. He demonstrated all prerequisite behaviors required for participation in the study, and demonstrated mastery of receptive identification of 23 black-and-white images. All sessions were conducted by instructors who were novel to Mark (three members of the research staff), and took place in Mark’s typical instructional setting. Mark was able to use his AAC device to provide a limited set of responses to questions (e.g, yes, no, and personal information like family names, phone number, and address). He was also able to request preferred items, activities, and basic needs like the bathroom. Much of Mark’s programming was focused on reducing problem behaviors, including aggression like biting, scratching, hitting, kicking, grabbing, pushing, or head butting; disruptive behaviors including throwing, swiping, or slamming objects onto a surface, dumping materials, flipping tables, kicking things, or banging a surface with an open palm; spitting; and self-injurious behaviors in the form of hitting his head with a closed or open hand or hitting his head against any surface. Notable here, Mark's behavior plan stipulated that he rotate across three separate settings every 20 minutes during academic instruction: his classroom, a life skills room, and a conference room. Sessions were conducted in all three of these rooms across all phases of the study. Therefore, Mark's behavior plan inherently incorporated generalization across instructional settings throughout the study.

Materials

Materials included 150 black and white novel stimuli drawn from Dube, Iennaco, and McIlvane (1993), 23 black-and-white mastered stimuli identified for Mark, and 6 black-and-white ecologically valid novel stimuli to be used during a generalization session at the end of the study.

Throughout the study, Mark's instructors provided token reinforcement on a fixed ratio of one token for every correct response (FR1), and every five tokens Mark was provided access to preferred reinforcers. Mark was most often motivated by activity-based rewards like taking a walk and using an iPad, which were provided for 1 min when he traded in five tokens. In addition to using his iPad, additional preferred items (e.g., games, play-dough) and edibles (e.g., chips) were included as potential 1-min reinforcers and were selected by Mark during a brief MSWO upon completing his reinforcing activity when the token board was reset. Instructors utilized data sheets and pens to collect data. A video camera was used to record sessions to assist with IOA data collection.

Mark used his standard SGD to produce the functional communication response required. The device was a touch-screen iPad with the Proloquo2Go application used solely for communication purposes. The functional response was touching an icon that was located in the center of the rightmost side of his second screen; the second screen was accessible by a left swipe. On the second screen, there were eight distractor icons Mark had previously learned for other communication purposes.

Dependent Measures

Data were collected manually on a data sheet for all experimental conditions based on the following dependent measures:

Accuracy of the responses. Data were collected on the accuracy of Mark's responses (i.e., correct, incorrect, or no response) for mastered and novel stimuli for all trials throughout all conditions. Correct responses were defined as selecting the correct item for a mastered or novel stimuli within 5 s of presentation. Incorrect responses were defined as selecting an incorrect item within 5 s of presentation. No response was defined as the absence of selecting an item within 5 s of presentation. Accuracy for mastered items was measured as the percent of correct responding on mastered items in each session, and calculated by dividing the number of correctly selected items by the number of total mastered trials in that session, multiplied by 100. Accuracy for novel items was measured as the percent of correct responding for novel items in each session, and calculated by dividing the number of correctly selected novel items by the number of total novel trials in that session, multiplied by 100.

Response position. During both novel and mastered tasks, the position of Mark's responses (left, middle, or right) was recorded for all trials to assess for position biases. The percent of trials during which the participant responded to each position for each session were calculated by dividing the number of trials the participant responded to a given position by the total number of trials in the session, multiplied by 100. A bias was considered to have emerged when the participant allocated 80% or more of his responses to a particular position for two consecutive sessions.

Use of the functional communication response. The use of the functional communication response, “I don’t know” (IDK), was recorded during each session for all phases for mastered and novel tasks. The percent of IDK responses was calculated separately for mastered and novel tasks in each session by summing the number of trials during which Mark independently produced an IDK response when asked a question, and dividing that by the total number of opportunities to use the response, multiplied by 100. Note that each new trial in every condition presents an opportunity to use the FCT response. Mastery of the functional communication response during the training, FCT, and mixed phases was considered to be 80% or higher for two consecutive sessions. Mastery of mastered tasks was defined as selecting 80% or higher of the correct stimuli for all sessions during all conditions.

Experimental Design

A single case, ABAB reversal design was utilized in this study to evaluate the effects of the functional communication procedure on increasing the use of the appropriate functional communication response as well as on reducing biased responses. Because our research utilized single case design procedures, experimental control was to be demonstrated with only one participant. Specifically, in single case design, each subject acts as his or her own control. Repeated measures of Mark’s behavior within each phase of the study allowed us to compare experimental variables as they were introduced across the conditions. Theoretically, we would be able to demonstrate experimental control within our reversal design through removal and reimplementation of our independent variable (i.e., the functional communication procedure) and the observation of repeated changes in behavior (e.g., an increase in the use of the functional communication response and a decrease in biased responding following introduction of the independent variable).

Procedure

Prior to the start of the study, a pre-assessment was conducted to ensure Mark was able to correctly identify at least 20 2 in x 2 in laminated black-and-white mastered images with 100% correct responding across two trials during a receptive identification task with an array of three mastered stimuli. These correctly-identified mastered targets were used throughout the duration of the study. Pre-assessment was also conducted to ensure Mark was unable to correctly identify (0% correct responding across two trials) six 2 in x 2 in laminated black-and-white ecologically-valid novel stimuli that were to be used for the generalization session at the end of the study. All other novel stimuli used in the study were 2 in x 2 in laminated black-and-white nonsense images drawn from Dube, Iennaco, and McIlvane (1993) whose labels were randomly assigned one-syllable nonsense sounds (e.g., “zut”), therefore assessment was not required to ensure Mark was not able to receptively identify the nonsense images.

Two sessions were conducted each day for Mark, initially two to three days each week; modifications discussed below increased study frequency to five days a week. All sessions were conducted during school hours, and the total duration of all sessions lasted no longer than 30 min per day. Each session consisted of 12 discrete trials (i.e., one block) of mastered stimuli and 12 discrete trials of novel stimuli, and the mastered and novel stimuli presented varied each session. The order of mastered and novel blocks was alternated each day to counteract order effects. Prior to each session and immediately following reinforcement, a brief MSWO procedure was conducted to select backup reinforcement for Mark's token system.

For all initial phases (excluding the 6-block phase, mixed phase, and maintenance/generalization phases, described in subsequent sections), the instructor alternated between mastered and novel blocks receptive identification task. In this task, Mark was presented with an array of three stimuli each trial, and was asked to point to a correct picture when asked to select an item. At the start of each trial, he was asked the question, "Where is [item label]?" and was provided with praise and token reinforcement upon selecting the correct stimulus, or for providing the FCT response, depending on the condition. Then the next trial in that block was introduced with another set of three stimuli. The position of the stimuli was counterbalanced each session, in that they were all equally represented in each position within each session. Each novel stimulus was the target twice per block before being added to the rotation of 150 items again to discourage participants from learning the novel stimuli. Similarly, each mastered stimulus was the target only twice per block, and was then placed in the rotation with remaining mastered stimuli before being used again.

Baseline. During baseline, the participant was presented with alternating blocks of mastered and novel items. The instructor asked, "Where is [item label]?" For both mastered and novel tasks, Mark was reinforced with praise and a token for selecting the correct stimulus. For incorrect or no responding after 5 s, the instructor moved on to the next trial. The reinforcement schedule used in this condition was designed to mimic typical classroom conditions where biased responding can sometimes contact reinforcement. When a position bias emerged (defined as two consecutive sessions with 80% responding or greater to one particular position or stimulus), then the FCT training phase was introduced.

FCT training. During the FCT training phase, mastered target blocks were presented as during the baseline condition, and Mark continued to be reinforced for selecting the correct targets. During blocks of novel stimuli, the instructor presented the targets and immediately followed with a 0-s time delay gestural prompt by pointing to the “IDK” icon on Mark’s iPad. Correct responses—defined as selecting the “IDK” target following a prompt—were followed by token reinforcement and praise from the instructor. Incorrect responses or failing to respond within 5 s of the prompt were immediately followed by the re-presentation of the gestural prompt until the appropriate response was emitted. After three consecutive correct responses with a 0-s prompt, a 5-s time-delay gestural prompt was introduced, and the gestural prompt was faded to a general point towards Mark’s device. After an error or non-response, the instructor said, “If you don’t know something, you can always press” and then provided a gestural prompt to his device. After three consecutive errors, the instructor returned to the 0-s delay prompt until three consecutive correct responses under that condition was demonstrated again. Acquisition criterion for the FCT response was two consecutive sessions of correct independent functional communication responding for 80% of opportunities or greater. Then the FCT phase was introduced.

FCT phase. During the FCT phase, reinforcement continued to be provided for correct responding to blocks of mastered stimuli; if Mark selected the “I don’t know” button for mastered targets, the instructor followed by saying, “Take a guess” or “Choose one,” and did not provide any reinforcement. For novel trials, reinforcement was provided only for Mark selecting the “I don’t know” button on his device. Any other responses during blocks of novel stimuli were considered incorrect. After an incorrect response, the instructor said, “If you don’t know something, you can always press” and then provided a faded gestural prompt to the “IDK” button on his device. No reinforcement was provided following the error, and the instructor then immediately moved on to the next trial. Acquisition criterion in the FCT phase was two consecutive sessions of correct independent functional communication responding for 80% or greater of opportunities. Once this criterion was met, a return to baseline was introduced.

Return to baseline. During the return to baseline, the same reinforcement contingencies and procedures as the original baseline were reintroduced. Returning to baseline is a means of demonstrating control over the target communicative response; if the response reduces and biased responding re-emerges, then some control has been established. When biased responding re-emerged with 80% or greater allocation of responses to a particular position or stimulus, a return to the FCT phase was then introduced.

Return to FCT phase. During the return to the FCT phase, the same reinforcement contingencies and procedures as the original FCT phase were reintroduced. During this phase, if a re-emergence of the appropriate communication response emerges, then control of the behavior by the intervention is strongly indicated. When Mark demonstrated two consecutive sessions of correct independent functional communication responding for 80% of opportunities during this baseline phase, then the 6-trial block phase was introduced.

6-trial block phase. The 6-trial block phase is an intermediary step between separate blocks of novel and mastered stimuli and mixed blocks of novel and mastered stimuli. Again, no prompting was used in this phase, and the consequences to correct/incorrect responding followed that of the FCT phase. However, the instructors implemented shorter blocks of six trials for mastered and novel blocks, using six stimuli in each block. That is, each stimulus was the target only once in the block (instead of twice during the 12-trial block conditions). When Mark emitted correct independent functional communication responding for 80% of opportunities or greater during the first session of the 6-trial block phase, then the mixed block phase was introduced. If Mark did not emit 80% or greater correct responding, then the phase would have continued until Mark emitted the correct functional communication response in 80% of opportunities or greater for two consecutive sessions.

Mixed phase. This condition was included to increase the learner's attending to stimuli and demonstrate mastery of the discrimination between appropriate responding to novel and mastered stimuli on rapidly alternating trials. During the mixed block phase, each session comprised only one block of trials, not two, and the block consisted of 12 trials of three novel and three mastered stimuli, with no more than two mastered or two novel stimuli presented consecutively. As with previous FCT conditions, whenever Mark selected the correct mastered stimuli during a mastered trial, he was reinforced, whereas he was reinforced for providing the functional communication response during novel trials. The same consequence procedures were used in response to errors as in prior FCT conditions. Mark was considered to have acquired mastery when he demonstrated correct responding across both novel and mastered stimuli at 80% or greater with two consecutive trials.

1-week maintenance. One week after acquisition of the mixed block phase, one session of the mixed block phase was introduced to assess maintenance of the FCT response over time. Regardless of performance on the maintenance session, the generalization session immediately followed.

Generalization. After presentation of the 1-week maintenance session, the participant took a 5-min break and then the generalization session was provided. During this session, a mixed block format was used with six mastered and six novel stimuli. The novel stimuli consisted of six black-and-white ecologically valid images identified as novel and unmastered for Mark during the pre-assessment. This generalization session was implemented to identify if Mark was able to use the functional communication response when presented with novel stimuli other than the images drawn from Dube and colleagues (1993).

Interobserver Agreement (IOA)

All sessions were video recorded, and data for interobserver agreement (IOA) was collected by an additional research staff member for all of the dependent measures (response position, accuracy of the response, and use of the FCT response) through video review or live observation. Trial-by-trial IOA was collected for 35.8% of sessions. Percent agreement was calculated by dividing the number of trials with agreement between the experimenter and reliability observer by the total number of trials (agreement and disagreement combined), multiplied by 100. Reliability is generally considered to be 80% agreement or greater, and results for each dependent variable indicate that reliability for response position was 97.7% with a range between 66.7% and 100%; reliability for correct responses was at 99.3% with a range between 88.3 and 100%; and reliability for use of the FCT response was 100%.

Modifications

Three modifications were introduced at two points in time during the course of the study, which will correspond with two arrows indicated in Figures 1, 2, and 3. Mark failed to demonstrate acquisition of the FCT response during initial study conditions described above replicating Torricelli et al.'s (2017) study. Initially, a second FCT training phase with the same study conditions was introduced. By the seventh session of the second FCT training phase (session 42 overall), Mark demonstrated a consistent behavior chain where he selected a position bias before selecting the IDK response. To address this, slower-progressing prompt levels across full blocks were introduced at 0-s, 1-s, 2-s, and 5-s prompts, so that Mark had to demonstrate mastery (80% or greater) during a block at each level before progressing to the next prompt level. Additionally, Mark's frequency of study participation increased from an average of two days a week to up to five days a week to create more consistent learning opportunities. This modification also began during the seventh session of the second training session.

A final modification was introduced during the 12th session of the second FCT training session (session 47 overall) as Mark continued to have difficulty demonstrating high rates of correct responding during the 1-s prompt delay condition. To reduce response effort for the FCT response and increase response effort for the position bias, Mark's AAC was placed in front of the stimuli rather than beside the stimuli, and the stimuli were therefore located farther from Mark on the table. This modification was incorporated for both novel and mastered trials, and it is noteworthy that this change did not interfere with Mark's ability to continue to demonstrate mastery of mastered items. This modification occurred during the twelfth session of the second training session.

Results

Figure 1 depicts the percentage of Mark's responses allocated to the left, middle, and right positions in the array across all mastered trials in each session. Figure 1 indicates that Mark responded consistently across all positions (approximately 33%); specifically, Mark responded to left position mastered trials 33.6% of the time, middle position mastered trials 33.8% percent of the time, and right position mastered trials 32.3% percent of the time, which reflects the frequency with which each of the mastered target stimuli were placed in each position.

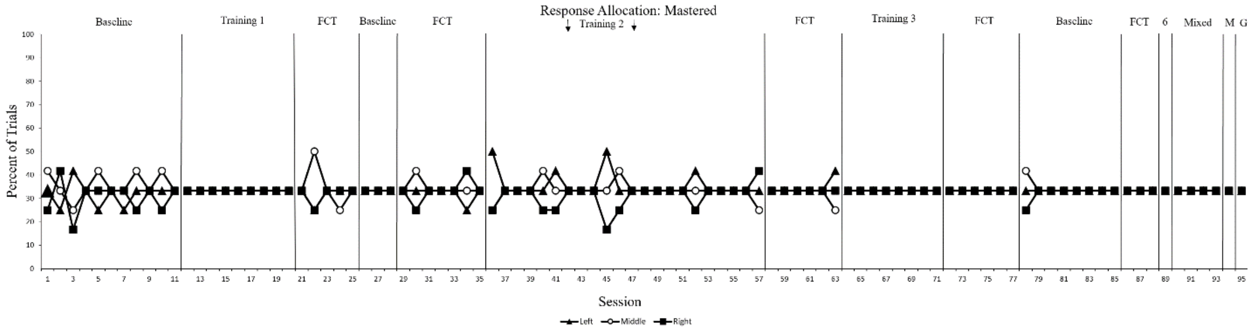

Figure 1. Response Allocation for Mastered Trials.

Figure 2 depicts the percentage of Mark's responses allocated to the left, middle, and right positions in the array across all novel trials in each session. It should be noted that the ideal outcome for Figure 2 will reflect Mark allocating his responding to FCT responses (IDK) during novel trials, and therefore not responding to any positions within the array during FCT conditions. Allocation to a specific position for 80% or more of trials indicated a position bias. Figure 2 shows that, initially, Mark alternated between a middle position bias and a left position bias during baseline, until he ultimately demonstrated a consistent middle position bias. The bias was eliminated during FCT training sessions and reduced to near-zero levels, briefly re-emerged during the FCT phase but then was eliminated again, and then re-emerged as predicted during baseline when he again allocated more than 90% of his responding to the middle position. However, contrary to predictions, Mark demonstrated a strong left position bias in the first return to the FCT phase. A second FCT training session was introduced that eliminated the left bias, however, his middle bias unexpectedly increased during the third FCT phase. A third FCT training was required, at which point Mark's biased responding was eliminated entirely.

Overall, Mark demonstrated biased responding (80% or greater) towards the left position during at total of seven sessions: once during the initial baseline, once during the second baseline, and five sessions (out of the seven total sessions) of the second FCT condition. Mark responded with a middle position bias for five sessions during the initial baseline, one session during the first FCT condition, twice during the second baseline condition, and once during the third FCT condition, for a total of nine sessions across the course of the study. Mark did not display a right position bias at any point during the study.

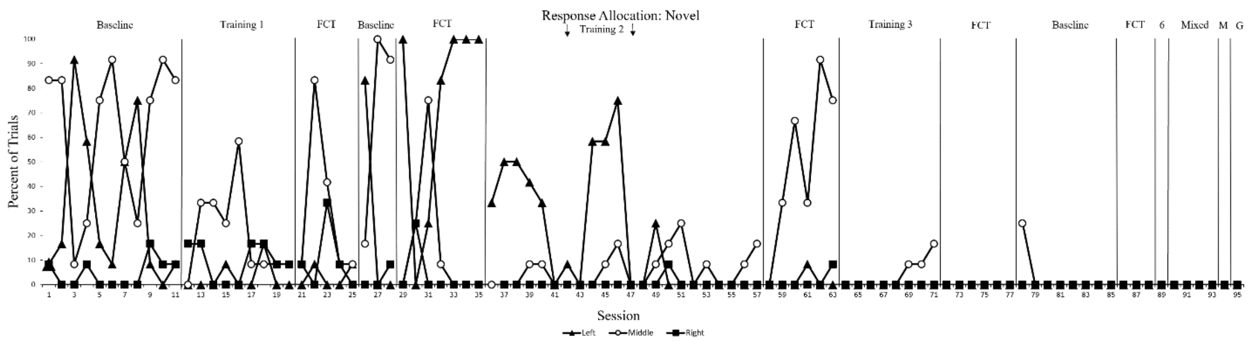

Figure 2. Response Allocation for Novel Trials.

Figure 3 displays “correct” responses across all conditions, or the percent of trials during which Mark correctly selected the stimulus that corresponded to the instructor’s question. In Figure 3, correct responses were reinforced for all mastered sessions, however, they were only reinforced for novel sessions during the baseline condition. All other novel sessions involved an FCT correction procedure whenever Mark selected a target stimulus. Across the duration of the study, Mark responded with an average of 97.1% correct responding to mastered items, demonstrating continued mastery of the material. Figure 3 indicates that Mark largely maintained mastery criteria (80% or greater correct responding) for mastered items consistently throughout the duration of the study as well, with only one session (session 45) falling below mastery criteria. Of note, the most common error Mark demonstrated during mastered trials was due to difficulty discriminating between black-and-white images of a plate and a bowl in the same trial. The images were subsequently separated for future trials beginning with session 46 during the second FCT training phase when Mark fell below mastery criterion (<80%) solely due to errors related to failure to effectively discriminate between the bowl image and the plate image.

Figure 3—and specifically the novel items data path—also provides information on how Mark's accuracy of responding reflects mastery of the IDK response as well. Figure 3 shows that Mark responded with an average of 31.0% correct responding to novel tasks during the initial baseline, indicating chance accuracy expected during novel tasks. Mark's accuracy dropped to an average of 10.2% during the training sessions, which was also expected as Mark began to allocate more of his responding to the IDK response. His accuracy remained low during the FCT phase as well, at an average of 16.7% accuracy (with a slight increase due to a session or two with high biased responding). When the return to baseline was introduced, accuracy subsequently increased back to chance-level responses, with an average of 30.5% correct responding. It seems, however, that the same level of responding persisted into the next FCT condition, as Mark continued to select targets with an average of 31.0% accuracy, indicating persistent engagement with the novel stimuli rather than a return to using the IDK response. The second training phase was introduced, and we were able to return Mark's responding to an average of 9.5% accuracy during that condition, similar to the initial training phase.

Unfortunately, the third FCT saw an increase back to chance accuracy responding, indicating yet another return to biased responding (with an average of 22.2% accuracy across the condition). A third training was required to re-teach effective use of the FCT response, at which point a much more significant mastery of the FCT response was demonstrated by Mark, as reflected in his lack of stimulus selection, indicated in near-zero rates of accuracy: he responded with an average of only 2.8% accuracy in the third training, followed by 0% accuracy in the following FCT condition, 1% accuracy in the third baseline condition, and finally 0% accuracy across all subsequent conditions (another FCT, 6-block, mixed, maintenance, and generalization conditions). For Mark, true mastery of the FCT response appears to be best reflected by near-zero engagement with the novel material, which had not been consistently demonstrated in the early training conditions. The pattern of responding demonstrated in Figure 3 likely reflects Richling, Williams, and Carr’s (2019) call to increase mastery criteria to promote better maintenance of skills, as will be addressed further in the discussion section.

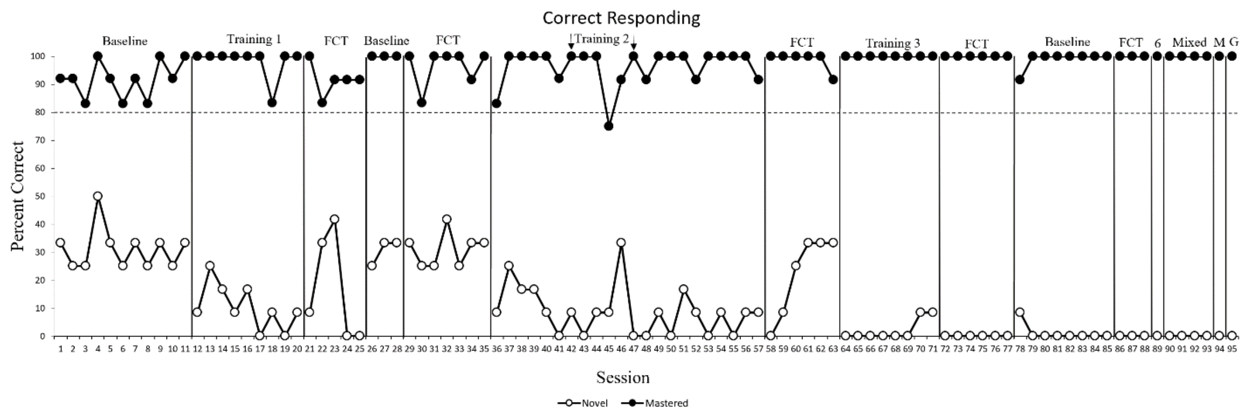

Figure 3. Percent Correct Responding on Novel and Mastered Trials.

Figure 4 shows the percent of trials in which Mark effectively produced the FCT response, “IDK,” during all tasks. A close look at the data highlights the impact of Mark’s variable responding on his maintenance of the FCT response during novel tasks. During the initial training phase, Mark technically met the minimum mastery criteria with two consecutive responses at 80% or greater independent responding of the FCT response. During this initial training phase, Mark demonstrated independent use of the IDK response – that is, appropriately selected IDK before any prompt – during an average of 37.9% of opportunities. During the following FCT phase, although Mark technically met mastery criteria for three of the five sessions, his use of the IDK response during novel tasks was only at an average of 56.7% of trials. This was followed by a baseline session in which he did not engage in using the IDK response at all. It is perhaps not surprising, then, that the following FCT session did not result in effective use of the FCT response but rather near-absent rates of the FCT response, with an average of only 8.3% IDK use across three sessions. During a prolonged second training, which required the introduction of multiple modifications, Mark demonstrated independent responding in an average of only 15.5% of opportunities, with some continued reliance on prompting during even the latter sessions. The use of IDK during the following FCT phase fared somewhat better at an average of 52.8% of trials, but responding was still highly variable and lower than expected. Mark most benefitted from a third training session, with improved independent responding at an average of 61.5% of opportunities and mastery-level performance for four consecutive sessions. In the FCT trial following the third training, Mark's use of the IDK response was 100% of trials across all sessions for the following FCT condition, an average of 96.9% of trials for the final baseline condition, and 100% of trials across all sessions for all subsequent phases.

Figure 4 also shows a single session in which Mark provided the IDK response during a mastered trial. Specifically, Mark selected IDK during the first trial of a mastered block that immediately followed a novel block. While the response may indicate an inappropriate overgeneralization of the IDK response to mastered stimuli, the single instance of his use of IDK during a mastered trial appears to be more likely due to a lack of attending to the change in stimuli at the onset of the new mastered block. Given that he immediately returns to appropriate responding to mastered stimuli, this single instance across of inappropriate IDK use across 95 total sessions does not appear to undermine conclusions drawn about the strength of Mark's effective discrimination between novel and mastered images and corresponding responses.

In summary, Figure 4 highlights Mark's high variability and low consistency in responding during initial FCT training and early FCT conditions, as well as the improved efficacy of IDK responding once all study modifications were in place in FCT Training 3. Upon mastery of the IDK response during the third training session, Mark did not return to biased responding during baseline as is expected in a reversal, and he maintained mastery-level rates of IDK responses for all remaining sessions.

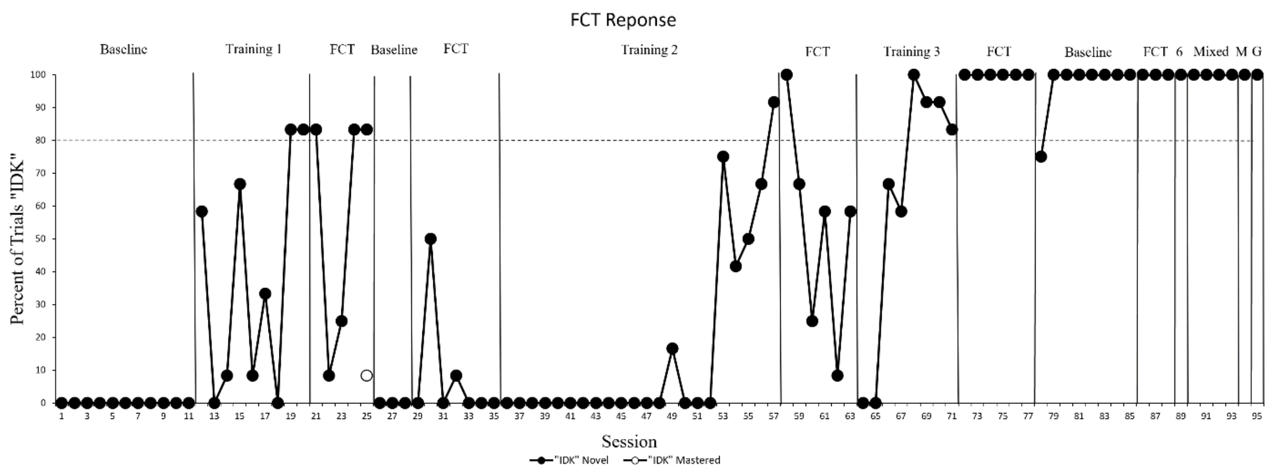

Figure 4. Independent Use of the FCT Response.

Discussion

The present study is the first to identify if position biases emerge during novel tasks for non-vocal learners with ASD who utilize AACs like speech-generating devices. This study sought to replicate typical classroom instruction and reinforcement conditions that may inadvertently reinforce learners' use of biased responses. When position biases emerged, this study then introduced an intervention to reduce biased responding. Given the efficacy of FCT as a means to reduce challenging problem behaviors and increase appropriate behaviors during academic instruction (Carr & Durand, 1985; Durand & Carr, 1991), as well as its efficacy for children who rely on AACs (Durand, 1993; Durand, 1999; Hagopian et al., 1998; Wacker et al., 2005; Walker, 2018), this study implemented and investigated the efficacy of an FCT procedure as a potential intervention to reduce the learner's position biases and improve prosocial assistance-seeking during academic instruction. Importantly, introducing a help-seeking response has broader social and communication implications for children with ASD, including improving effective task completion, initiating social contact, increasing language exposure, and promoting a broader learning about the world (Shillingsburg et al., 2011). Information-seeking is even more important, and more challenging, for low- and non-vocal children with ASD due to low social motivation and numerous barriers to effective communication like limited expressive repertoires. Therefore, the present study is an important step towards expanding the literature on both barriers and tools relevant to improving help-seeking for individuals with ASD who have limited communication.

There are only three studies to date that investigate procedures to teach manding for information for low- or non-vocal learners (Carnett & Ingvarsson, 2016; Carnett et al., 2019; Shillingsburg et al., 2019), and only one pilot study that has sought to use manding for information as a functional communication response to offset position biases (Torricelli et al., 2017). This study utilized the manding for information response, "IDK," first introduced by Ingvarsson and colleagues (2007) for children with and without developmental disabilities, further investigated by Ingvarsson and Hollobaugh (2010) for four children with ASD, and later used by Carnett and Ingvarsson (2016) for a child who relied on an SGD. Further, this study sought to replicate the procedure developed by Torricelli and colleagues (2017) to teach IDK as a functional communication response to address biased responding in vocal children with ASD, expanding the procedure to facilitate the use of IDK as a functional response for a child who relies on an SGD. Importantly, we addressed several limitations Torricelli and colleagues identified in their study, including increasing discrimination requirements between novel and mastered tasks by making all novel and mastered images black-and-white. Given Torricelli and colleague's study relied only on nonsense novel images developed by Dube and colleagues (1993), we also evaluated Mark's use of the IDK response when he was presented with ecologically valid novel stimuli during the final condition of the study (e.g., a plug or a shell). Mark's ability to generalize the FCT response to this new set of stimuli further highlights the reliability and generalizability of FCT responding, and more importantly suggests that the functional communication response IDK can be effective in typical classroom settings where new items may be introduced among mastered items during discrete trial instruction.

Despite some limitations inherent to the study design, this study provides information about how position biases develop, approaches to treatment of biased responding, and the variables that may impact that treatment, specifically in a non-vocal learner with ASD. Each of these points is discussed below.

How Biased Responding Emerges

Previous research indicates that biased responding can emerge following instruction that does not take into account the influence of instructional variables that create faulty stimulus control (Green, 2001). However, a small body of research indicates that biased responding or other inappropriate responses may emerge when a learner is presented with unknown tasks (Torricelli et al., 2017). In the current study, to reduce the likelihood that biased responding emerged due to variables related to instructional design, we incorporated many of the key elements Green (2001) identified to prevent biased responding during general instruction. These instructional guidelines included balancing stimuli across all positions equally and unsystematically, using three items in the instructional array, presenting different stimuli each trial while maintaining the same comparisons (in this case, alternating between two sets of three stimuli each block), and requiring foundational skills for match-to-sample task to be included in the study.

This study did not incorporate some of Green's recommendations. First, errorless learning procedures were not used. This omission was necessary to evaluate if common classroom reinforcement procedures (i.e., the presence of reinforcement for selecting the correct stimuli, and the lack of reinforcement for selecting the incorrect stimuli) affected the development of biased responding. Second, Green recommends arranging stimuli out of view to reduce the risk that the learner responds to extraneous cues like the image the instructor touched first or last. In the current study, stimuli were arranged to the side of Mark, in view, and then were slid over to be situated in front of Mark. A review of several early videos indicated that Mark demonstrated low attending to the instructor during setup, and that his responding did not show a consistent response pattern related to instructor setup. Therefore, the particular instructional element related to instructional setup does not appear to have impacted Mark's development of a position bias.

In order to effectively evaluate whether biases develop in response to novel stimuli, this study utilized a high number of nonsense images pulled from Dube and colleagues (1993), paired with nonsense syllables, to control for the effects of learning. That is, novel images remained novel throughout the study. This differs from most other similar manding-for-information studies that utilized actual classroom learning targets to investigate the effects of learning with variable success (Carnett & Ingvarsson, 2016; Carnett et al., 2019; Ingvarsson & Hollobaugh, 2010; Ingvarsson et al., 2007; Shillingsburg et al., 2019). Our prioritization of maintaining novel images to control for learning allowed us to adequately evaluate the effects of novel images on the development of biased responding consistently throughout the course of this study. Additionally, maintaining a large set of novel stimuli allowed us to demonstrate Mark's adaptive use of the FCT response consistently from the initial training conditions up until the mixed blocks later in the study, during which we unsystematically alternated mastered and novel trials.

Because we incorporated several best-practice instructional procedures into the study design, and because we utilized material that ensured our novel images remained novel for the duration of the study, our hypothesis that learners develop biased responding in the presence of novel stimuli was further strengthened when Mark demonstrated the emergence of position biases. Specifically, during baseline, Mark was able to demonstrate consistent responding across all positions during all the mastered tasks. However, during the novel condition, when the setup and conditions were the same except for the presence of novel images instead of mastered images, Mark immediately demonstrated high rates of biased responding from the very first session. This suggests that the presence of the novel stimuli under typical reinforcement is a condition in which Mark—and, likely, other learners—have previously been reinforced for biased responding, or eventually learn to engage in biased responding to access reinforcement with minimal effort. This certainly expands on the literature on an important but under-investigated factor influencing the development and maintenance of biases.

Treatment of Biased Responding

Past research has addressed biased responding primarily through manipulating reinforcement quality, quantity, magnitude, immediacy, or rate (Bourret et al., 2012; Galloway, 1967), or through correction procedures (Bourret et al., 2012; Kangas & Branch, 2008). Despite some of the success identified in the above studies, limitations persist, most notably with reinforcement manipulations. For example, Galloway (1967) found that altering reinforcement quantity shaped participant responses away from their bias, but found that a biased responses re-emerged for two of their four participants when the previous equal-reinforcement condition was reintroduced. Correction procedures do have evidence of efficacy; Kangas and Branch (2008) found that a repeated-trials correction procedure was effective at quickly reducing biased responding in five pigeons. This was expanded by Bourret and colleagues (2012) to humans, who found that, for two of their participants, biased responding was only eliminated with a correction procedure (using blocking and manual guidance) combined with reinforcement magnitude manipulations, despite previous failed attempts to reduce biases with reinforcement quality and magnitude manipulations alone.

Given the variable efficacy of reinforcement manipulations on reducing biased responding, as well as the fact that correction procedures like response blocking may function as a punishing event (Leaf, Sheldon, & Sherman, 2010; Lerman & Iwata, 1996; Worsdell et al., 2005), we looked beyond the current standard consequence strategies to address biased responding. Instead, we introduced an intervention that would not only reduce biased responses across a range of tasks, but have the potential to prevent them from developing in the future. By framing biased responding as a “problem behavior” that interfered with academic instruction, we were able to introduce a functional communication response, IDK, through FCT to replace the biased response. Admittedly, FCT was developed for more disruptive and challenging problem behaviors, like aggression, tantrums, and self-injury (Carr & Durand, 1985), and much of the research has followed suit (Tiger et al., 2008). However, given FCT’s success with several studies of less distressing but still persistent and disruptive problem behaviors, like stereotypy or echolalia (Tucker, O'Dell, & Suib, 1978), we hypothesized that FCT would be an appropriate procedure for biased responding as well.

Variables That Impact FCT

Mark was able to learn the FCT response after the initial training trials, however, his variability of responding suggests he did not have full mastery of the response. Therefore, when he failed to maintain the response during condition reversals, our observations led to several study modifications that were introduced to better meet the learning needs of Mark, and these findings may be able to extend to other low- and non-vocal children who rely on aided AACs.

Mastery criteria. One modification we were able to implement during the study to improve the reliability of Mark's IDK response was the minimum criteria we established for mastery in the training sessions, which had originally been set at two consecutive sessions at 80% responding or greater with progressively fading prompts. Specifically, by the third training, we required a minimum of four consecutive sessions at mastery before changing conditions, in part to ensure that mastery persisted across days, consistent with the recommendations by Luiselli, Russo, Christian, and Wilczynski (2008). Mark was able to demonstrate four consecutive sessions of independent responding by beating extended prompting procedures (see below) during the 2-s and 5-s prompts.

Given the powerful effects of intermittent reinforcement on maintaining a behavior like biased responding, as well as the potential learning history of the participant in biased responding prior to the study, a modification for higher criteria for FCT mastery enabled Mark to encounter more learning trials and increase overall reinforcement for effective independent use of the IDK response, strengthening Mark's use of functional communication. This may be particularly important for low- or non-vocal learners for who broadly display less fluency and require more time and more frequent trials to learn effective communication responses. Richling, Williams, and Carr (2019) found that the most commonly used mastery criterion of 80% responding across three consecutive session resulted in poorer maintenance than higher mastery criteria requiring additional acquisition sessions, like 90% or 100% responding. Although we did not formally increase mastery criterion to 100% during the third training, it is notable that Mark demonstrated 100% responding during all but one of the 24 sessions that followed the third training, confirming and further reinforcing Mark's mastery of the FCT response.

Increased frequency of learning opportunities. Another mid-study modification included more frequent learning opportunities throughout the week, from two to three days a week up to five days a week. Broadly, more frequent learning opportunities improve communication outcomes for children with ASD (Lovaas, 1987; National Research Council, 2001; Siller & Morgan, 2018), particularly as children with ASD often lack social motivation or pre-requisite communication skills to create naturalistic learning opportunities themselves.

Extended prompting procedures. Perhaps the most significant structural change we made to the study was to modify the prompting procedures during training sessions. We used a delayed prompting procedure in this study in part because it has been found to be more time-efficient in regards to speed of acquisition, direct instruction time, and percent of errors when teaching responses than prompts requiring increasing assistance like least-to-most prompting (Bennett, Gast, Wolery, & Schuster, 1986; Demchak, 1990; Gast, Ault, Wolery, Doyle, & Belanger, 1988; McDonnell, 1987). MacDuff, Krantz, and McClannahan (2001) recommend that prompts be faded as quickly as possible, and Torricelli et al.'s (2017) prompting procedure follows this recommendation by fading from a 0-s prompt delay to a 5-s prompt delay within sessions. However, when used in the current study, the same prompt fading procedure resulted in further errors that interfered with acquisition. Our participant was often able to provide the FCT response with a 0-s prompt, but the 5-s prompt did not prevent him from providing a biased position response in the intervening 5 s while waiting for a prompt.

Anecdotally, Mark’s responses overall were much faster than the two vocal participants in Torricelli et al.’s (2017) pilot study, which indicated that a more prolonged and slowly-faded prompt procedure might better support Mark’s response speed. Delayed prompts can teach skills and transfer stimulus control from the prompt to the relevant cue quickly and effectively (MacDuff et al., 2001), and increasing the delay more gradually over successive trials is generally better at shaping the behavior while offsetting prompt dependence (Oppenheimer, Saunders, & Spradlin, 1993). Therefore, we introduced blocks of 12 trials at each prompt level and required 80% correct responding or greater before moving to a block with a more delayed prompt. Mark began with a block of 0-s prompts, mastery of which resulted in the presentation of a block of 1-s prompts, then a block of 2-s prompts, and finally a block of 5-s prompts. The slower prompt-fading procedure resulted in Mark demonstrating more reliable FCT responding, and overall supports MacDuff et al.’s (2001) conclusion that individual characteristics of learners (e.g., children who demonstrate slower acquisition of new skills, or high-speed responders who are prone to error, like Mark) should be considered when ultimately determining prompting procedures.

Response effort. Research shows that greater response effort can lead to greater disruptive behaviors and reduce compliance (Boelter et al., 2007; Fischetti et al., 2012; Friman & Poling, 1995). This becomes relevant when teaching functional communication skills using AACs, as using communication methods in which participants are less fluent can result in an increase in problem behaviors (Martin, Drasgow, Halle, & Brucker, 2010). Ringdahl and colleagues (2009) found that using high-proficiency response topographies have better FCT outcomes than low-proficiency response topographies.

By designing the study so that Mark had to use his SGD to provide the IDK response, we intentionally selected a response that allowed for differential reinforcement of an incompatible response (DRI) to the biased responding. That is, we did not expect that Mark could both select a biased response and engage in the FCT. For Mark, however, his responses were quick and the presence of reinforcement for selecting the target response on his SGD did not prevent him from engaging in both the biased response and the target response within the span of about 1 s. In fact, he began to chain the two responses together, biased response followed by the FCT response, which had to be addressed.

When Mark began demonstrating the behavior chain, we began to suspect that engaging in biased responding required less response effort than selecting the IDK button on his device. One way to consider Mark's responses is that, through many repeated trials over years of discrete trial instruction, stimulus selection is a very high-proficiency response for Mark. Conversely, while he has used his speech-generating device for some time, using buttons on the iPad to communicate is a somewhat lower-proficiency response that, in the context of this study, requires more cognitive and physical effort than stimulus selection.

Other variables impacted Mark's response effort as well. For example, the instructional array was located immediately in front of him, whereas his device was placed in variable positions depending on where Mark placed it when first sitting down—most commonly to the right of the instructional array. Additionally, the IDK response was located on the second screen on the rightmost side of the device. Although Mark is right-handed, he demonstrated left or middle biases, which indicates that reaching far to the right to select IDK is against his identified preference and therefore likely requires additional effort. Device placement also affected error correction procedures. When the instructor pointed to the device and stated, “Remember, you can always say ‘I don’t know’” after an error during training and FCT phases, sometimes the prompt had minimal visual impact as it was conducted to the side of Mark and was near the instructor, and sometimes the prompt was more visually disruptive as the instructor’s arm crossed the instructional array to reach the device.

Given these numerous complications related to device placement, a modification was introduced to create consistency as well as reduce overall response effort for the FCT response: Mark’s device was placed immediately in front of him, and the instructional array was placed above the device. In this way, Mark had to reach over the device to access the stimuli, which was successful at interrupting his chained error and improving his functional communication response. Notably, this modification did not impact his ability to maintain mastery-level responding for mastered trials.

Research already suggests that children who are proficient in vocal speech prefer that communication modality to aided and unaided AACs during FCT (Harding et al., 2009). This may mean that while a vocal FCT response, once learned, requires less effort than physically selecting instructional stimuli (as in Torricelli et al., 2017), physical responses using SGDs by nature continue to require more response effort than using biased responding, given the required steps including turning on the device (if the screen is off), scanning for the communication target among distractor stimuli (sometimes requiring scanning across multiple screen pages), and finally physically selecting the response. Fortunately, our study modifications suggest that adjusting AAC and stimuli placement alone can be sufficient to break position biases and behavior chains and increase ease of mastery of the FCT response. This opens possibilities for future research on the potential impact of response effort on biased responding vs. use of functional communication for low- or non-vocal children by modifying variables like device, target response, and stimulus placement.

These results have significant implications in the development and use of functional communication training for children who utilize speech-generating devices and other aided AACs. Using the functional response must be less effortful than engaging in the problem behavior, and seemingly minor variables—like the location of communication targets on the device and device placement relative to the instructional array—can become barriers to effective FCT implementation. We already hypothesized that learning novel tasks requires greater effort than accessing reinforcement through biased responding; additional added effort to use an FCT response may further maintain biased responding in low- and non-vocal children with autism.

Limitations and Future Directions

The primary limitation of our study is our inability to demonstrate experimental control of the FCT response. In replicating Torricelli et al.'s (2017) study, an ABAB reversal design was selected. The initial lack of reversibility of the FCT in the ABAB reversal design demonstrated a lack of control over the FCT response. Specifically, after the initial training, Mark was unable to maintain consistent and reliable increases in his FCT response while simultaneously reducing his position bias. When he did meet initial minimum mastery criteria and baseline conditions were re-introduced, Mark immediately returned to biased responding. While this, at minimum, demonstrates one reversal, we were unable to replicate treatment effects during the return to the FCT condition, and thereby could not maintain experimental control throughout the course of the study (Cooper et al., 2014). Torricelli and colleagues (2017) were able to demonstrate control over the behavior through their reversals using the same design for vocal learners with ASD; however, they did use longer FCT sessions before reversing conditions.

Once the desired behavior—the FCT response—was fully mastered at session 72, Mark was unable to reverse back to biased responding in baseline. The irreversibility of the FCT response may indicate that the learned FCT behavior cannot be unlearned. This persistence of the FCT responde despite lack of reinforcement is, in many ways, a strength of the response: a learner may persist in using the appropriate response whenever it is needed, despite the pull of the same reinforcement contingencies that promote biased responding.

One way future research may choose to address the above lack of reversibility would be through the use of a multiple baseline design, which is the most widely used experimental design as it is flexible and avoids issues related to reversibility (Cooper et al., 2014). In a multiple baseline study, different behaviors, settings, and/or subjects act as controls for each other. Indeed, many similar manding-for-information studies have prioritized using multiple baseline designs. For example, Taylor and Harris (1995), Ingvarsson and Hollobaugh (2010), and Carnett and colleagues (2019) utilized a multiple baseline across participants; Ingvarsson and colleagues (2007) utilized a multiple baseline design across responses; and Carnett and Ingvarsson (2016) utilized a multiple baseline across sets. Multiple baseline designs do, however, have some limitations, the most notable of which is that it does not demonstrate experimental control, merely a functional relation. Similarly, the extended baselines inherent to multiple baseline design can result not only in repeated exposure to lack of knowledge, but also encourage repeated errors, which may further reinforce an already-persistent behavior like biased responding. A nonconcurrent multiple baseline design would still enable researchers to investigate the application of the learned FCT response across different novel stimuli while avoiding issues related to prolonged baseline conditions. The potential limitation of such a design, of course, is its reduced predictive power and potentially masked interdependence of variables influencing behavior.

While we maintained the study design within the present study, the modifications we introduced to facilitate Mark's learning, discussed in the preceding section, did increase Mark's reliability in producing the FCT response with novel stimuli in place of his biased position responses. Additionally, later study conditions like a mixed phase and a generalization trial to ecologically valid stimuli extend the strength of Mark's demonstration of mastery of the FCT response.

Yet it should be noted that the mid-study modifications had some limitations as well. For example, immediately after introducing the modifications, Mark was still unable to maintain the appropriate FCT response, and a third training phase (with the same modifications included) had to be re-introduced, fortunately to greater effect the second time. This suggests that the FCT response was not trained to competency even with the study modifications. It may also suggest that the re-emergence of the biased responding may be under the control of some unknown variable, or is simply a stronger and more embedded response that requires less response effort than a newly-trained functional communication response. Future studies may seek to improve upon the training procedures from the beginning—including improving frequency of instruction, mastery criteria, prompting strategies, and response effort—to further maximize learners' development and strength of the identified FCT response.

Another consideration is that, while this study was able to successfully teach the FCT response, this study did not address the issue of using a recruiting response, such as "I don't know, please tell me" (Carnett & Ingvarsson, 2016; Ingvarsson & Hollobaugh, 2010; Ingvarsson et al., 2007). While this study sought to avoid the effects of learning, future studies should seek to teach a recruiting response using more ecologically valid stimuli to examine the impact of the response on learning. It would also be worthwhile to thin reinforcement for the IDK response away from the FR1 schedule used in this study, which is a frequency does not often align with reinforcement procedures applied in classrooms and other settings. Realistically, most learners do not receive any tokens or rewards for asking for help during tasks, except as the relevant information is naturally reinforcing by increasing access to other possible reinforcers. Researchers like Ingvarsson and Hollobaugh (2010) did not actively reinforce the help-seeking response, but rather reinforced the correct answer that the child learned after stating IDKPTM. While we did not take this approach, one notable benefit to Mark's failure to reverse his IDK response in the third baseline condition is that he persisted in using the FCT response despite lack of reinforcement across eight consecutive sessions. This lack of reversibility demonstrates the possibility that some learners may maintain the FCT response even in low- or no-reinforcement conditions.

Other features of this study that may have impacted performance were the elements of generalization embedded throughout the procedure; as part of his daily behavior plan to address challenging behavior, Mark was required to change settings every 20 min. This resulted in study procedures being implemented across three different settings. Additionally, increasing the frequency of instruction required the involvement of two additional staff members to implement the study procedures. We were unable to assess the impact of introducing multiple instructors throughout the course of the study on Mark's behavior. The current investigation has the advantage of incorporating elements of generalization; however, those very elements may also have impacted Mark's responding to some uncertain degree. Given the importance of using a help-seeking response across contexts, generalization is a key consideration in this research, and our participant was ultimately able to generalize the skill across three settings, three instructors, and over a hundred novel images as well as a separate set of ecologically valid stimuli.

Importantly, the IDK FCT response is a generalized skill that may lead to learning a variety of new answers to questions across any number of environments. Future generalization considerations may include incorporating colorful novel and mastered stimuli to reflect images children will encounter in their classrooms and outside school. Studies may want to investigate generalization across a broader range of settings (e.g., home, community), instructors, stimuli (e.g., three-dimensional objects), and even, perhaps, to more abstract concepts like activities described in Shillingsburg and Valentino's (2011) study (e.g., asking for help when the sound is muted on the computer or when the snack closet is locked). Future research should also evaluate procedures that enable children with autism and other developmental disabilities to actively seek out learning opportunities and recruit prompting and instruction from adults and peers in their everyday environments.

One final limitation is the fact that our study had only one participant. While single case designs do not require additional participants as the individual acts as their own control, Mark's responding was fairly idiosyncratic. Study modifications that were included to address issues related to his speed of responding, development of behavior chains, and response effort, may not apply to other learners. Our lack of comparison participants therefore limits the extent to which we can generalize these results to other learners. However, the efficacy of these modifications for Mark may warrant further consideration in future studies seeking to improve communication skills in other low- or non-vocal learners.

Conclusion

Despite its limitations, this study is the first to explore if position biases emerge when a non-vocal child with ASD is presented with novel stimuli. Additionally, this study investigated the efficacy of an FCT procedure to replace biased responding with an appropriate communication response, IDK. This study empirically demonstrates that position biases do emerge during novel tasks, and highlights the necessity of an FCT intervention that utilizes high mastery criteria, frequent sessions, gradual delayed prompting procedures, and low response effort to successfully teach the FCT response. Study results indicate that our participant was able to successfully discriminate between the conditions that required an IDK response—novel tasks—and those that required the correct selection of mastered stimuli. This effective response discrimination persisted when blocks of novel and mastered trials were mixed and alternated unsystematically, and was generalizable across instructors, settings, and stimuli.

The findings of the current investigation have significant implications. First, these findings broaden the field's understanding of factors that influence the development of biased responding, specifically that they can develop in the presence of novel stimuli when learners lack an effective help-seeking communication response. Secondly, this study is the first to frame biased responding as an academic-interfering problem behavior in low- or non-vocal children with ASD that can be reduced with functional communication training using assisted AACs like a speech-generating device. Third, this study was successful in teaching the FCT skill to mastery, to such a degree that the IDK response persisted despite lack of reinforcement during baseline conditions. Although more research is needed, these findings taken together indicate that low- and non-vocal children with ASD are capable of effectively seeking help during academic tasks, as has been supported by previous research (Carnett & Ingvarsson, 2016; Ingvarsson & Hollobaugh, 2010; Ingvarsson et al., 2007). It also suggests FCT may be an effective strategy to teach communication responses like IDK that can further prevent the development of biases in the future by enabling learners to access additional information and support using their AACs.

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Appendix A

PARENTAL INFORMED CONSENT

Functional Communication Training to Decrease Biased Responding During Academic Tasks in Non-Vocal Individuals with Autism Spectrum Disorder

You are invited to participate in a research study that is being conducted by Audrey Torricelli, Psy.M. BCBA, who is a student in the Graduate School of Applied and Professional Psychology at Rutgers University. The purpose of this research if teaching a functional communication response is effective at reducing biased responding (e.g., incorrectly repeatedly responding to the same position or same item during each trial of instruction) during academic tasks in children with autism spectrum disorder who utilize speech-generative devices.

Approximately 2-3 subjects will participate in the study, and participation will last approximately 3 months**.** Sessions will take place 2-3 times a day for no more than 30 minutes total, over 2-3 days a week. We will work with the classroom teacher to identify a time that will be minimally disruptive to the student and the classroom.

Participation in this study will involve the following:

1. First, to determine whether participants have biased responding, they will be asked to receptively identify mastered and novel stimuli. The participants will receive preferred items or activities for correctly identifying pictures when they are named by the instructor. We are looking to see if biased responding (e.g., only selecting items in a particular position) emerges for participants during the presentation of novel tasks.
2. If biased responding emerges, then we will teach the participant an appropriate response, “I don’t know,” for the participants to use with their speech-generating devices when they are presented with novel tasks. The participant will be reinforced with preferred items and activities for using the “I don’t know” response during trials of novel stimuli. This procedure is called Functional Communication Training. We will confirm the effects of the intervention by returning briefly to the first phase (above) before re-implementing Functional Communication Training.
3. We will then slowly increase the mix of mastered and novel tasks to determine whether the participants are able to give the “I don’t know” response for novel trials while selecting correct instructional items during mastered trials.
4. If the learner is able to show mastery of providing appropriate responses for both mastered and novel stimuli, then one week after mastery is reached we will check to see whether the skill was maintained and whether it generalizes to new pictures that were not used previously.

This research is confidential. Confidential means that the research records will include some information about you/your child and this information will be stored in such a manner that some linkage between you/your child’s identity and the response in the research exists. No personal identifiers or personal health information will be collected. Please note that we will keep information confidential by limiting individual's access to the research data and keeping it in a secure location. Consent forms with identifying information will be stored in locked file cabinet separate from data collected for the study. Upon consent, participants will be provided a numerical code which will be used in place of identifying information on all subsequent data collection forms and data analysis.

The research team and the Institutional Review Board at Rutgers University are the only parties that will be allowed to see the data, except as may be required by law. If a report of this study is published, or the results are presented at a professional conference, no identifying information will be included. All study data will be kept until 5 years after completion of study procedures.

Risks or participation will be minimal. At most, participants may experience agitation through repeated instructional trials. However, they will access reinforcement frequently in order to minimize frustration. Additionally, if frustration escalates to the point where precursor behaviors (e.g., jumping up and down in instructional chair) to more problematic behaviors (e.g., aggressions towards others or self injury) emerge, sessions will be terminated. Importantly, efforts will be made to terminate sessions *before* more problematic behaviors occur.

You have been told that the benefits of taking part in this study may be: your child may acquire a help-seeking "I don't know" response on their speech-generating device that may be used to indicate uncertainty or confusion during academic tasks. However, you may receive no direct benefit from taking part in this study.

Participation in this study is voluntary. You may choose for your child not to participate, and you may withdraw your child from participating at any time during the study activities without any penalty to your child. In addition, you/your child may choose not to answer any questions with which you/your child are not comfortable.

If you/your child have any questions about the study or study procedures, you/your child may contact me at

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My faculty research advisor can be contacted at

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If you/your child have any questions about your rights as a research subject, you may contact the Institutional Review Board (a committee that reviews research studies in order to protect those who participate). Please contact an IRB Administrator at the Rutgers University, Arts and Sciences IRB:

Institutional Review Board
Rutgers University, the State University of New Jersey
Liberty Plaza / Suite 3200
335 George Street, 3rd Floor
New Brunswick, NJ 08901
Phone: 732-235-2866
Email: human-subjects@ored.rutgers.edu

You will be given a copy of this consent form for your records.

Sign below if you agree to allow your child to participate in this research study:

Name of Child (Print) ____

Name of Parent/Legal Guardian (Print) ____

Parent/Legal Guardian's Signature ___________________ Date ______________________

Principal Investigator Signature _____________________ Date __________________

Appendix B

Study Update

Functional Communication Training to Decrease Biased Responding During Academic Tasks in Non-Vocal Individuals with Autism Spectrum Disorder

We are contacting you to give you an update on your child's participation in the above study and notify you of several changes approved by our Institutional Review board. As a reminder, our study involves 4 separate stages:

1. First, to determine whether participants have biased responding, they will be asked to receptively identify mastered and novel stimuli. The participants will receive preferred items or activities for correctly identifying pictures when they are named by the instructor. We are looking to see if biased responding (e.g., only selecting items in a particular position) emerges for participants during the presentation of novel tasks.
2. If biased responding emerges, then we will teach the participant an appropriate response, "I don't know," for the participants to use with their speech-generating devices when they are presented with novel tasks. The participant will be reinforced with preferred items and activities for using the "I don't know" response during trials of novel stimuli. This procedure is called Functional Communication Training. We will confirm the effects of the intervention by returning briefly to the first phase (above) before re-implementing Functional Communication Training.
3. We will then slowly increase the mix of mastered and novel tasks to determine whether the participants are able to give the "I don't know" response for novel trials while selecting correct instructional items during mastered trials.
4. If the learner is able to show mastery of providing appropriate responses for both mastered and novel stimuli, then one week after mastery is reached we will check to see whether the skill was maintained and whether it generalizes to new pictures that were not used previously.

Data collection was estimated to last for three months, and occurs 2-3 times a day for 2-3 days a week.

You child is currently nearing the end of Stage 2 above; we found that your child did engage in biased responding during novel receptive identification tasks. We taught him to select an "I don't know" item on his speech-generating device using Functional Communication Training. We are currently confirming the effects of the intervention by briefly returning to the first phase and, as biased responding re-emerged, we have begun to re-implement Functional Communication Training.

As we approach the three month mark, we are finding that the original estimate of study duration does not allow the study to progress through all the steps of the study, which is designed to promote discrimination between which skills to use for novel and mastered tasks. The final stage further allows us to investigate your child's generalization of skills with novel images of real objects.

We are sending this letter to notify you that we are extending the study up to two additional months, for a total of five months of study participation. We also are planning that we adjust data collection to encourage more continuous learning opportunities – while also decreasing the daily burden on participants – by increasing data collection to occur between 2-5 days a week, but for only 1-2 times a day.

As a reminder, participation in this study is voluntary. You may choose for your child not to participate, and you may withdraw your child from participating at any time during the study activities without any penalty to your child. In addition, you/your child may choose not to answer any questions with which you/your child are not comfortable.

If you/your child have any questions about the study or study procedures, you/your child may contact me at

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My faculty research advisor can be contacted at

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If you/your child have any questions about your rights as a research subject, you may contact the Institutional Review Board (a committee that reviews research studies in order to protect those who participate). Please contact an IRB Administrator at the Rutgers University, Arts and Sciences IRB:

Institutional Review Board
Rutgers University, the State University of New Jersey
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Appendix C

FCT To Reduce Biased Responding
Data Collection Form

Participant:____________________________ **Date:** ___________________ **Trial #:** __________

Mastered / Novel (circle)

Item A: _____________________ Item B: _____________________ Item C: _____________________

Item D: _____________________ Item E: _____________________ Item F: _____________________

	LEFT	MIDDLE	RIGHT	Response (Item or FCT)
Trial 1	A	**B**	C	
Trial 2	**D**	E	F	
Trial 3	**C**	A	B	
Trial 4	F	D	**E**	
Trial 5	B	C	**A**	
Trial 6	E	**F**	D	
Trial 7	**A**	B	C	
Trial 8	D	**E**	F	
Trial 9	C	A	**B**	
Trial 10	**F**	D	E	
Trial 11	B	**C**	A	
Trial 12	E	F	**D**	

FCT To Reduce Biased Responding

6-Trial Block Data Collection Form

Participant:______________________________ **Date:** _____________________ **Trial #:** ___________

Mastered / **Novel** (circle)

Item A: _____________________ Item B: _____________________ Item C: _____________________

Item D: _____________________ Item E: _____________________ Item F: _____________________

	LEFT	MIDDLE	RIGHT	Response (Item or FCT)
Trial 1	A	**B**	C	
Trial 2	**D**	E	F	
Trial 3	**C**	A	B	
Trial 4	F	D	**E**	
Trial 5	B	C	**A**	
Trial 6	E	**F**	D	

FCT To Reduce Biased Responding
Mixed Phase Data Collection Form

Participant:____________________________ **Date:** ____________________ **Trial #:** __________

Mastered / Novel (circle)

Item A: _____________________ Item B: _____________________ Item C: _____________________

Mastered / Novel (circle)

Item D: _____________________ Item E: _____________________ Item F: _____________________

	LEFT	MIDDLE	RIGHT	Response (Item or FCT)
Trial 1	A	**B**	C	
Trial 2	**D**	E	F	
Trial 3	**C**	A	B	
Trial 4	F	D	**E**	
Trial 5	B	C	**A**	
Trial 6	E	**F**	D	
Trial 7	**A**	B	C	
Trial 8	D	**E**	F	
Trial 9	C	A	**B**	
Trial 10	**F**	D	E	
Trial 11	B	**C**	A	
Trial 12	E	F	**D**	