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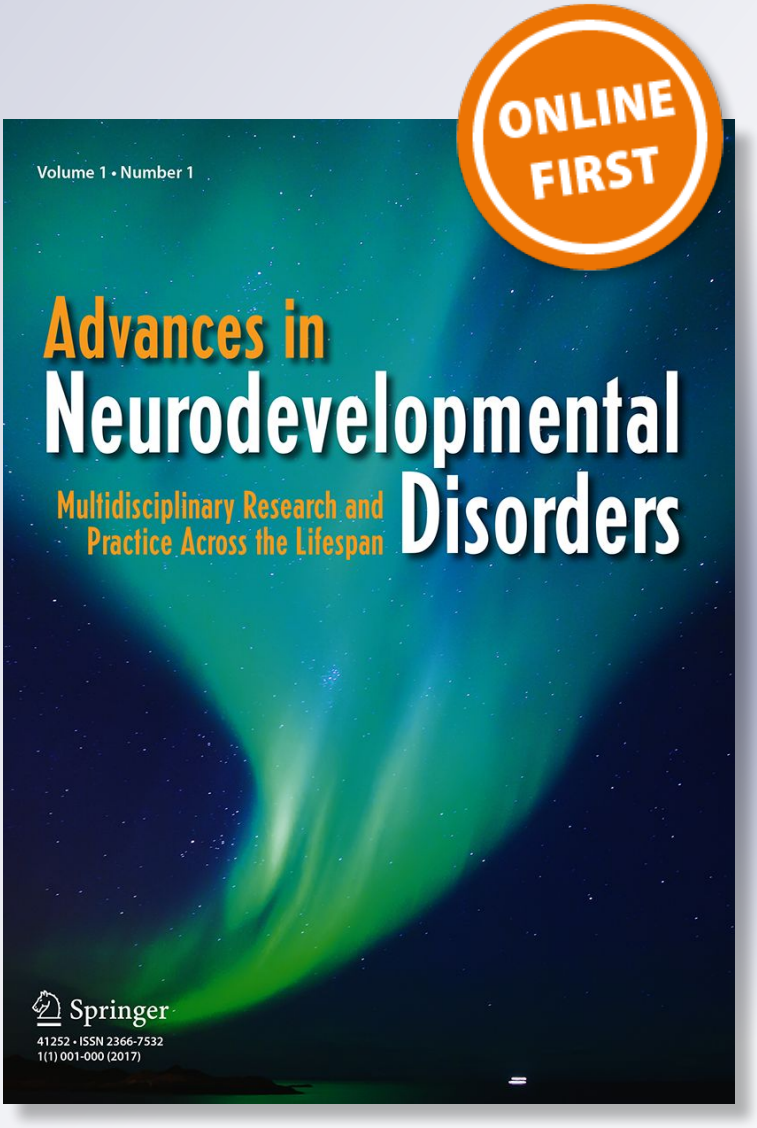
Advances in Neurodevelopmental Disorders
Multidisciplinary Research and Practice Across the Lifespan

ISSN 2366-7532

Adv Neurodev Disord
DOI 10.1007/s41252-019-00127-9



Springer

Advances in Neurodevelopmental Disorders
https://doi.org/10.1007/s41252-019-00127-9

ORIGINAL PAPER

Issues Related to AAC and SGD Use by Adolescents and Adults with Autism Spectrum Disorder

Andy Bondy[1]

Abstract

The use of technology, especially speech-generating devices (SGDs), has generated a great deal of attention. In order to assess the quality and effectiveness of such strategies, many issues related to terminology and teaching require careful attention. The first section begins with a discussion about functional communication, including long-term goals, from a behavioral perspective. Key issues will include speaker vs. listener distinctions, functional units, and factors related to expanding communication repertoires. The next section reviews SGDs, their popularity, and concerns such as distinguishing between *toy use* vs. *communication device* and the role of the audio output. Next, factors related to demonstrations that a user *knows* the meaning of words in different modalities will be considered. There follows a look at some research examples related to both SGD and picture use by adolescents and adults with ASD regarding functional communication. This section includes examples of studies that appear to have overestimated functional outcomes as well as noting the overall paucity of research demonstrating a robust gain in repertoire size and complexity. Lastly, suggestions are offered associated with determining how clinicians can assure that efforts to teach functional communication to individual teenagers and adults will result in effective outcomes.

Keywords Speech-generating devices · Autism spectrum disorders · Alternative/augmentative communication · Functional communication · Picture exchange communication system

The use of new technology has always offered hope for solving or ameliorating long-standing problems in education. For example, communication difficulties are part of the core features of autism spectrum disorders (ASD) and many believe that improved technology can be helpful to achieve or improve functional communication. With the accelerated development and advancement of various speech-generating devices (SGD), including a host of apps for various types of mobile technology such as smart tablets (e.g., the iPad™), the use of such devices is being promoted as a veritable panacea for this population. The field of alternative/augmentative communication (AAC) offers a variety of interventions, especially for very young children who are having difficulty acquiring functional speech, that may either be used in place of speech or have a positive (augmentative) effect upon the use of speech. AAC also has been used to help improve functional communication skills of adolescents and adults, often with lower expectations on changes in speech production.

Clarifying the main goal of providing communication training for those displaying difficulty in acquiring communication skills, whether through speech or an alternative modality, will first be considered. The long-term goal is to help a learner acquire robust functional communication skills that are readily used in various settings and with numerous potential communicative partners. Clearly defining *robust* will be somewhat arbitrary but can be contrasted with the term *minimally verbal* which is often used to describe individuals who demonstrate significant difficulties in acquiring functional speech. A distinct operational definition of minimally verbal varies from fewer than 5 to 20 spoken words (Tager-Flusberg and Kasari 2013). Therefore, it is suggested that at least 50 communicative *units* (uniquely articulated spoken words, differentiated signs, discriminated pictures/icons, etc.) would represent a robust outcome. Thus, interventions that yield 5 to 10 units may be viewed as promising or individually helpful but certainly not robust. Finally, various settings should minimally involve school/work, home and the community each of which would involve at least four or five distinct communicative partners.

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Published online: 10 September 2019

In general, there has been substantially more research on AAC strategies with children than with adolescents or adults (Ganz 2015). There have been two recent publications which comprehensively reviewed such strategies with adolescents and adults. Holyfield et al. (2017) noted in their abstract, "Results indicate that AAC intervention benefits adolescents and adults with autism spectrum disorder." (p. 201) Lang et al. (2014) stated, "Overall, the studies summarized in this chapter reported generally positive results." (p. 135) Thus, two systematic reviews of the extant literature concluded with positive statements regarding the effectiveness of AAC strategies with this distinct population.

For individuals with ASD, reaching adolescence or adulthood without reasonably robust speech skills is associated with a number of significant challenges. First, a recent review by Pickett et al. (2009) regarding speech acquisition in older individuals with ASD noted that they could find no cases of successful speech acquisition for those older than 13 years. Next, a review of outcome measures and predictors for adults with ASD (Magiati et al. 2014) noted that higher levels of language skills were associated with better overall outcomes for this population. Furthermore, there has been a long history of studying the relationship between specific communication deficits and the occurrence of challenging behaviors at all ages (see Durand and Moskowitz 2015 for a full review). Finally, reviews of the use of SGDs with children with ASD have emphasized an overabundance of studies focusing solely on requesting (Gilroy et al. 2017) and therefore, it is important to examine whether this tendency holds true with adults as well. In short, whatever is the evidence for the efficacy of SGDs with children with ASD, an independent examination regarding adolescents and adults with ASD is warranted.

As noted, the two published reviews regarding AAC for adolescents and adults with ASD provided positive overall conclusions. There are a number of important conceptual and factual issues that appear to have been neglected which seriously limit these conclusions. These issues will be systematically introduced, using specific publications involving adolescent and adults with ASD and related significant disabilities to highlight what is lacking or even misleading in the general field. At the conclusion, a set of guidelines will be suggested that can help clinicians make informed choices about AAC systems, modalities, and teaching strategies.

What Is Functional Communication?

A commonplace definition of *communication* can be found on Wikipedia as "…the activity of conveying information through the exchange of ideas, feelings, intentions, attitudes, expectations, perceptions or commands, as by speech, nonverbal gestures, writings, behavior and possibly by other means such as electromagnetic, chemical or physical phenomena and smell. It is the meaningful exchange of information between two or more participants" (http://en.wikipedia.org/wiki/Communication).

In 1992, the American Speech-Language Hearing Association (ASHA) defined communication in the following manner: "Communication is any act by which one person gives to or receives from another person information about that person's needs, desires, perceptions, knowledge, or effective states. Communication may be intentional or unintentional, may involve conventional or unconventional signals, may take linguistic or nonlinguistic forms, and may occur through spoken or other modes. Thus, all persons do communicate in some way; however, the effectiveness and efficiency of this communication vary with a number of individual and environmental factors." (p. 2; National Joint Committee)

These definitions involved terms such as ideas, *feelings*, *intentions*, and *thought*s—each of which is fraught with difficulty when it comes to inter-observer agreement. That is, while it may be agreed that many people have ideas, feelings, and thoughts—some of which may involve intentions—people often argue about whether someone else has *conveyed* information, thoughts, etc. Furthermore, by stating that "all persons do communicate in some way," ASHA does not provide an operational definition, but rather a more political one since it cannot be shown that all people respond to or interact with other people in a communicative manner.

Skinner (1957) wrote about behavior with the assumption that tools of science can be used to study human behavior. A core feature of science is that it is a group activity relying upon agreement with regard to particular events under study. In other words, a science about human behavior can only be developed by defining it in terms of measurable actions about which independent observers can concur with reliability, including what is colloquially called communication. Thus, Skinner's definition of verbal behavior was initially succinct, "…behavior reinforced through the mediation of other people." (p. 2) Later in the book, he refined the role of the communicative partner thusly, "…the 'listener' must be responding in ways which have been conditioned *precisely in order to reinforce the behavior of the speaker* [by the verbal community]…." (p. 225)

Skinner was making a sharp distinction between behaviors reinforced directly by environmental changes, such as picking up a piece of candy from a table, and behaviors reinforced through the mediation of someone else, such as interacting with another person who in turn provides the candy on the table. When someone is observed picking up a slice of pizza from a table, it may be inferred that she is hungry or that she wants the pizza, but that inference is not the equivalent of her doing something to another person. Perhaps she would act the same way whether there was another person in the room or not, in which case, the presence of someone else is irrelevant with regard to why she behaves in a particular manner. Were

she to do something to someone else in the room—talk, sign, write, exchange a picture, tap out Morse code, etc.—and that person then provides the slice of pizza, then Skinner's definition of verbal behavior would be satisfied.

Skinner made it clear that speech is not a necessary condition with regard to engaging in verbal behavior. "In defining verbal behavior as behavior reinforced through the mediation of other persons, we do not, and cannot, specify any one form, mode, or medium. Any movement capable of affecting another organism may be verbal." (p. 14) Herein, the word *verbal* as denoted by Skinner will be used to reflect a broad array of modalities, not solely limited to vocalizations.

Skinner's analysis relied upon a three-term contingency. Essentially, it is the study of *behavior under what conditions*. Some conditions involve events that occur prior to the behavior in question—the antecedents. And other conditions involve events that occur after the behavior in question—the consequences. Thus, for all verbal behavior, a necessary antecedent, or discriminative stimulus, is the audience or communicative partner. In time, a person may come to "talk to himself" but verbal behavior is acquired initially through interaction with other people—the audience. Behaviors that occur that are not under the stimulus control of a listener/audience would not be classified as verbal behavior. Furthermore, the communicative partner must provide the ensuing reinforcer in order for both conditions to be fulfilled. For example, when a teenager takes a smart tablet from my hand, while I may be within the environment the action may not depend upon anything that I do—I could simply function as furniture or a thing supporting the smart tablet.

This type of analysis also can be helpful when other types of distinctions between verbal and non-verbal behaviors are considered. For example, while it was noted that someone can engage in verbal behavior without speaking, someone can also engage in vocal behavior, perhaps even complex vocal behavior, without engaging in verbal behavior. For example, an adult may repeat a phrase, song or most of the lines in a movie and yet not receive any rewards from other people—she *enjoys* the sound of her own voice. Since the reinforcement was not mediated by someone else, this would be vocal but not verbal.

Consider someone interacting with something that produces sound, perhaps pushing buttons that result in speech-sounds emanating from an electronic device. Is this action communicative? Is it verbal behavior? If the person is interacting with the object while alone and continues to push buttons that result in sound, then the object would be classified as a toy regardless of the sounds produced (see Sobsey and Reichle 1989). That is, certain behaviors result in sound-production such as with a noise-making toy. In this playful scenario, communication would not be attributed to that user. However, when the buttons are pushed only when a communicative partner is present and the partner mediates access to reinforcement, then an interpretation of the use of a communication device would be warranted.

Another issue relates to how to analyze the use of pictures and how to attribute that action to the user. When a typical child says the word *balloon* colloquially, it would be said that she "knows the word *balloon*." Further observation, however, might reveal that she is merely imitating the sound pattern spoken by someone else, calling into question what she *knows*. For example, if she was a native French speaker and had never heard English speech, she might still imitate the sound pattern *balloon* but it would not be said that she "knew the word." Similarly, it is important to ask what it means when someone says, "She knows that picture" or "He knows the meaning of that picture." When a teenager is observed using a picture where it is the only one available, there is insufficient information to reasonably conclude, "she knows that picture versus other pictures." It is important to demonstrate that a learner discriminates between pictures or even sets of pictures. And finally, it is important to specify the best teaching strategies that yield adequate picture discrimination skills.

Types of Communication Skills

A common question when working with someone who displays limited communication skills within any modality is, *What skills should be taught first*? One way to make this choice is to consider the different outcomes for communicative acts. The consequences for verbal behavior may be viewed as involving two distinct types—one set involves outcomes that are direct or concrete while the other sets are social (or *educational* as described by Skinner (1957, p. 84). For example, someone could say (or sign, or exchange a picture, etc.) *ball* to a communicative partner and hence receive a ball. This example involves a direct or material outcome rather than a social outcome, such as someone saying, "Good job." An accounting for differing types of events that precede the particular skill also must be performed. When the antecedent conditions solely involved motivational factors and the outcomes are direct, Skinner classified this type of response as a mand. More colloquially, this type of communication could be noted as a request, command, demand, etc.

On the other hand, perhaps the individual engages in the same action in the presence of a ball on a table. The communicative partner says, "Yes! It is a ball" but does not provide the ball. Even so, the speaker appears to be content or even happy. In this case, the outcome was social and the antecedent involved the presence of the ball. This sequence would be colloquially considered a comment or naming and would be classified as a tact in Skinner's nomenclature.

Another potential source of control for communicative behaviors is the verbal behavior of other people. For example, when someone asks, "Tell me something we can play with"

and the response is *ball*, the antecedent—the question itself—clearly influences the reply. In this case, it is not a request for a ball and it is not in reaction to the presence of a ball (nor any of its features). Furthermore, the reinforcer in this case would be the social/educational reaction of whoever asked the question, such as praise (e.g., "Yes, we do play with a ball!"). Colloquially, this interaction could be viewed as part of a conversation or answering a question, while within Skinner's framework, it would be noted as an intraverbal.

It should be recognized that while the action itself is identical—saying *ball*—in each of the three cases, the antecedents and the consequences were different, and therefore, three distinct *behaviors* are identified. That is, requesting is distinct from commenting, and responding to someone else's verbal behavior is distinct from responding to purely motivational or environmental changes. Therefore, when attempting to teach a communicative act, such as saying, signing, writing, or using an icon *ball*, the conditions under which the lesson will be taught must be carefully considered.

When communicative target is selected to be taught, the type of reinforcers which will effectively influence the learner's behavior must be considered. For example, the behavior of individuals with ASD, especially when they are young, appears to be relatively insensitive to socially based outcomes (Bondy et al. 2004). The smiles, praise, and a happy tone of voice of other people may be minimally effective when trying to teach new skills. Thus, for someone with similarly weak reactions to social reinforcers, there is a need to select more concrete/materially based reinforcers, including but not limited to snacks, drinks, various toys, and various activities. In other words, teaching the mand before other verbal operants often is warranted.

Spontaneous and Multiply-Controlled Units

When antecedent conditions are addressed, issues related to *spontaneity* should be identified. Defining *spontaneous* is always tricky because most people begin by identifying what is *not* controlling the situation. For example, a spontaneous request for an item may be viewed as asking for that item *in the absence of* anyone else's verbal behavior (i.e., "What do you want?" "Tell me what you'd like," etc.). However, it is often appropriate to answer someone's question rather than initiate a particular comment. For example, we typically say "I'm fine" after someone asks, "How are you?" We do not walk up to someone and begin a conversation with, "I'm fine." Therefore, specifying what is controlling a particular behavior rather than what is *not* controlling behavior is to be strongly supported since the latter cannot be fully specified.

Within Skinner's book *Verbal Behavior* (1957), the formal definition of a mand involved current motivational factors in the absence of the associated item or outcome as well as the absence of any verbal behavior by the communicative partner. This *spontaneous request* may be viewed as a pure mand (Bondy et al. 2004). For example, a teenager asks for water when there is no water in sight and no one has said, "What do you want?" or something similar. Furthermore, this response results in the provision of water by the communicative partner. This response would be viewed as *spontaneous*. On the other hand, a second teenager only requests items when that item is in the immediate environment and an adult has asked a leading question. This type of request would not be credited as spontaneous.

Consider an adult who has been running around in the hot sun for a while, and upon seeing a cup of water, says, "Water!" and then quickly drinks the water. Both the motivation and the item are partially controlling the response and thus, the response is a mand/tact. However, when someone asks this same adult, "What would you like to drink?" (and there is no cup in sight), the response *water* is partially controlled by both the motivation and the verbal behavior of someone else, and thus would be identified as an intraverbal/mand. This type of analysis leads to an understanding that when requests occur only under such types of multiple-control, spontaneous requests (the pure mand) are likely to be rare. A similar analysis can be extended to comments or tacts. That is, when a teenager only names items following questions such as "What is this? What do you see?" but never solely in the presence of that item, then the response is not spontaneous. This analysis holds true independent of modality. Rather than contentious arguments about "What Lori knows" focus should be placed upon determining under what conditions Lori uses a particular word.

Issues Related to Language Complexity

An obvious goal when teaching communication skills is to expand the user's vocabulary. In clinical practice, those who speak 10 or fewer words are usually viewed as minimally verbal. Throughout this paper, the term *word* will be used loosely to reflect lay-use and will not be limited to speech unless other specified. Thus, a picture, a sign, a printed word, etc. will all be indicated as *a word*. An initial goal for these individuals would be to teach more than 10 words (independent of modality). However, while a broad goal aiming to increase the total vocabulary is worthwhile, such a goal should not be developed in isolation of other communication skills, such as the expansion of complexity via word combinations. Many view the mean-length-of-utterance (MLU, Brown 1973) as an important measure to assess such expansions although other measures may be helpful as well.

To quickly review, the aim of teaching someone to use a communication device or system involves a variety of goals. The user should engage in various functions, including

requesting/manding, commenting/tacting, conversational turns/intraverbals, acquire expansions such as attributes, and use different aspects of language that relate to social interactions. The user should use a large number of *words* and use sequences involving multiple words. The use of words should be both spontaneous and responsive. Communication users also should respond to the communication of others, whether within the same modality or a different one (e.g., a teenager uses pictures but responds to spoken instructions, an adult speaks but responds to visual instructions, etc.). Finally, the modality/form used should be readily and accurately responded to by people unknown to the user but common to the community (e.g., teaching someone to speak French in an English speaking community would not be functional).

Behavioral Development

The development of complex skills, including communication, can be best described as relying upon a scaffold of simpler skills. Typically, developing children learn language skills related to both direct and social motivation within specific environmental situations before learning qualifying content such as attributes, recurrence, and social modifiers. Children may learn to repeat (echo) particular words/phrases but they may not occur to correct environmental or social contingencies. Thus, a child may be directed to say "thank you" but until the child says this phrase under the appropriate social and situational conditions (i.e., upon the receipt of a gift), that child would not be credited as being *polite*. This analysis holds true for the use of pictures, printed words, or single electronic buttons connected to various forms of output. Therefore, pushing a button that results in a device producing the sound-sequence *Thank you* reflects polite language only when its use is under the proper circumstances, not merely because one heard the device produce *Thank you.* Furthermore, when someone activates a single button that results in the production of the sound-set equivalent to "I would like to go to my favorite restaurant" that is not the same behavior as when a typically developing children puts a series of units together to form that sentence. It is the analysis of the behavior that may lead to the observation that a sentence has been produced, not merely hearing the production of the sentence.

Furthermore, it is to be assumed, unless there is direct evidence to counter the assumption, that individuals with ASD will not outperform typically developing children with regard to the development of complex communication skills. For example, if it is known that typical speakers do not use the word *please* appropriately (i.e., under the contingencies set by the culture) until they have at least 300 total words, then it will be assumed that someone with ASD or some other developmental factor will also NOT use the word *please* until she has at least 300 total words.

Meaning, Discrimination, and Contrast

The use of technology does not guarantee the use of science, especially the use of the science of teaching. There is no reason to believe that simply exposing a learner to a sophisticated piece of equipment will lead to any better acquisition than simply exposing that learner to people who speak. Exposure is not a sufficient condition for the development of functional and elaborate responses (Bondy 2011). Thus, anyone who hopes that someone will learn to communicate (independent of the modality) must take into account how to teach. In a broad sense, teaching involves helping someone do something, and then removing the help, thus leading to new responses that become independent of the involvement of the teacher. For the most part, there are a variety of things a teacher can do to help performance. These include physical guidance, gestures, pictures, videos, written words, models, spoken words, and a host of environmental modifications. If a teacher uses such changes and this leads to successful performance, then what the teacher used is identified as a *prompt*. A prompt is defined by the successful impact upon the target behavior, just as reinforcers are defined by their impact upon target behaviors. The goal of using a prompt to help in performance is to eliminate the prompt resulting in a *cue* that now controls the behavior.

There are a variety of strategies that aim to remove various prompts but there are neither universal *best* prompts nor *best* prompt removal strategies. However, effective teaching requires clear identification of the prompt, the cue, and the strategy to transfer control and thus, each must be clearly specified within a publication. It should be pointed out that while shaping (Skinner 1953) can lead to learning, descriptions of this teaching strategy also require clear specifications of the changes involved within a lesson. Publications focusing solely on response production do not allow the specification of the conditions under which the target skill should occur. For example, if the training sequence involves a teacher saying, "Show me the picture of what you'd like to eat," it should not be assumed that the learner will automatically engage in the response without that specific prompt.

An important issue in the analysis of language involves the size of the unit of *a word*. For example, some young children may say what sounds like "wanna cookie." To assume that it is the two words most adults use—"want a"—is very risky unless differentiated use is observed. For example, use of *a* vs. *the* occurs for adults, but this distinction does not occur for children younger than about 4–6 years (Kemp et al. 2005). Toddlers do not sometimes say "wanna cookie" while at other times say, "want that/the cookie." Until such differentiated use is observed *wanna* should be attributed only as one unit. Broadly speaking, the assignment of grammatical distinctions that align with adult usage should not be made until differentiated responding supports such divisions.

Discrimination Issues

All communication systems require differentiated responding and some systems require visual discriminations. Systems that involve the use of pictures (or printed words, etc.) require teaching the user conditional discriminations, that is, select the cookie picture when hungry (or in the presence of cookies) but the juice picture when thirsty (or in the presence of juice). There are several factors that must be observed in order to demonstrate that appropriate discriminations have occurred.

First, in order for a discrimination to be observed, there must be at least two potential responses available. That is, pointing to (or picking up) the sole picture available does not demonstrate that a discrimination has been performed. Discrimination is required to assert that a user "knows the meaning" of a picture. For example, when a teacher places only a cup on the table and says, "Point to the cup," the ensuing point by the learner by itself does not indicate that the individual "knows what a cup is" or has made a discrimination. This discrimination can readily be tested by placing a cup and spoon on the table and alternating between "Point to the cup" vs. "Point to the spoon" (while randomly moving the placement of the two objects over trials). When the learner reliably points to the named item, then it is reasonable to assume that she discriminates between the two items and thus *understands* what was said. (It should be noted that the same analysis holds when pictures are used rather than objects.)

In a similar fashion, assume that a teacher shows a single object, a cup, and also a single picture of a cup, and then asks, "What is that?" When the learner points to the cup picture (or hands that picture to the teacher), no discrimination has been demonstrated because it cannot be assured since there is only one picture and one item available. A test for conditional discrimination can only be made when there are at least two items and two pictures. The analysis becomes even more challenging when testing for requesting an array of snacks and a matching set of pictures. For example, George points to/gives/pushes on the picture of *ball*. From this single action, it cannot be stated that he *knows* what the picture means or that he demonstrated discrimination between pictures. If the observation continues, it may be noticed that the receipt of any item available is readily used by him. That is, when George hands over a *ball* picture but the teacher provides a block, he appears happy to play with the offered block. Some learners are so sure that whatever picture they select will be followed by receipt of something rewarding that they do not bother to look at the pictures—all the pictures are winners. In this scenario, another strategy would have to be used to assure that discrimination has been made.

One such test for discrimination involves requiring the learner to select both the picture and then the corresponding item to test for discrimination (Bondy and Frost 1994; Frost and Bondy 2002). When a picture is selected, rather than providing the item, the instructor offers the array of items and indicates "Go ahead" (or something similar) without naming the item. (Should the teacher or device name the item then any resulting action with the ball could be due to the spoken statement and not the child's selection of the picture.) When the item the student takes consistently corresponds with the picture used then this observation supports that conditional discrimination has been made. When it is the teacher who provides the item, essentially assuming the meaning, then doubt remains.

There are a wide variety of discrimination training strategies, all based upon the systematic reinforcement of particular responses under the control of particular stimuli. Without varying stimuli in an organized fashion, it is impossible to demonstrate discriminative control by a single picture. What the voice *says* may or may not be what the device user *means* and the production of a sound-set that to us corresponds to a particular word does not guarantee that a discrimination has been made. Neither the manner of picture selection nor the complexity of the message produced by the device relate to determining the meaning of the behavior. Pictures, signs, or spoken words all acquire meaning by their use—by the conditions under which they are produced.

There also is a need to specify which particular action of the user will be targeted to be reinforced as verbal behavior. This specification is important so that a variety of communicative partners concur with regard to what action to reinforcer as well as when to reinforce. New skills require virtual immediate reinforcement (Pryor 1984). For example, in phase I of the picture exchange communication system (PECS) protocol (Bondy and Frost 1994), the targeted action involves putting a picture into the hand of the communicative partner, which immediately results in the provision of the reward. However, in phase III, discrimination training, the new skill involves the *selection* of the correct picture rather than placing it into the communicative partner's hand (which was acquired in phase I). Therefore, a conditioned or secondary reinforcer must be provided when the user selects the correct picture which occurs before handing it over. Actions involving devices require the same type of attention to the timing of provided reinforcement.

Research on Speech-Generated Devices

The next section will look at some of publications regarding SGDs in general before examining some of the studies that compare SGDs with other modalities. As there have been other systematic reviews regarding AAC with adults with ASD, critical communication and teaching issues will be addressed involving a number of studies to look for evidence of attention to the important factors that have been noted thus far.

Within the field of AAC, there has been a shift in terms regarding how best to describe electronic equipment that may be used to engage in communication. Voice-output-communication-aide (VOCA) was in vogue early in the development of this field but currently, the phrase speech-generating device (SGD) has supplanted the former term. Broadly speaking, the field of AAC initially sought to help individuals with various motor problems, either from birth or acquired (Vanderheiden 2002). These individuals were often viewed as having intact communicative intent and thus, the goal of intervention was to provide an alternative to speech that would yet involve functional communication. Gradually, the field became more involved with children with developmental disabilities (DD) who had not yet learned any mode of communication. Finally, the range of children with disabilities included those with autism spectrum disorder (ASD). The significant but often ignored issue with this latter population is the assumption of *communicative intent.* That is, when these children (and many others with DD) enter therapeutic or educational programs, few, of their behaviors would meet the previous definition of verbal behavior. In short, the issue of how to replace a current communicative repertoire with one with a different modality is distinct from the issue of how to teach someone to engage in behavior that is controlled by the presence of someone else who then mediates access to reinforcement.

Within the fields of AAC and autism intervention, there are relatively few strategies that are now considered *evidence-based*. One of these is the picture exchange communication system (PECS, Bondy and Frost 1994). In a review of non-medical interventions regarding autism published in *Pediatrics* in 2012, Maglione, Gans, Das, Timbie, and Kasari included PECS in a shortlist of interventions recommended for children with ASD. Other reviews, including Odom et al. (2010) and Gilroy et al. (2017), have also noted PECS as an evidence-based practice. Given the evidence that supports the use of PECS with children with ASD and other disabilities, many researchers compare relatively new strategies to PECS. While a number of authors now suggest that *picture exchange* can be viewed as a distinct modality, it is only the PECS protocol that has been found to be evidence-based.

A review of the extant literature regarding the use of AAC strategies with adolescent and adults with ASD yields few positive results. A recent review of this topic by Holyfield et al. (2017) found 16 publications that met their criteria (including defining adolescence as equivalent to 11 years and older). They concluded that there is evidence that AAC interventions provide benefit to this population. However, a perusal of the included studies shows individuals acquired very limited repertoires. Six studies involved a single icon and eight studies purported to involve eight or more messages-per-participant. One of these studies involved an adolescent who used an SGD to type, not to use icons. In another study, while credit was given for 73 messages, this total reflected the number of icons available, not the number of icons used. Similarly, while the review noted the use of 19 messages in a study by Hong et al. (2014), unfortunately, this figure reflected the number of icons on the device, not the number used. In fact, Hong et al.'s focus was on staff training and clearly stated that the learner did not acquire independent discriminated use of the icons. The publication by Trottier et al. (2011) also noted the number of pictures available without any data regarding discriminated responding. In short, of the publications cited as promoting eight or more icons, only one (involving 2 studies) demonstrated any discriminative control by the icons.

In another review, Lang et al. (2014) wrote a book chapter reviewing teaching functional communication to adults with ASD. As noted, they concluded, "Overall, the studies summarized in this chapter reported generally positive results." (p. 135) However, looking at each of the modalities summarized leads to a different conclusion. That is, they noted no published research involving adults with ASD supporting the use of direct speech training, virtually no support for sign or SGD use, and very little support involving PECS. In fact, none of the noted studies using any modality involved more than requesting preferred items, often without any discrimination.

One of the criteria used for selection by Holyfield et al. (2017) review was that all study participants were diagnosed as having ASD and were 11 years or older. Two publications not included in the review involved PECS in which at least one learner met both requirements. Charlop-Christy et al. (2002) involved three learners, one of whom had ASD and was 12 years old. This learner acquired all six phases of PECS and demonstrated improvement in several speech measures, including spontaneous speech and mean-length-of-utterance. Cummings et al. (2012) involved 7 learners, one who had ASD and was 11 years old. This individual also learned all six phases of the PECS protocol in a time frame deemed relatively efficient by the authors. Thus, in both studies using the PECS protocol with adolescents with ASD, learners acquired both requesting and commenting with simple sentence structure in a demonstrated discriminated fashion for both nouns and sentence starters in a reasonable time frame.

A study by Van Der Meer et al. (2013) purported to have taught two individuals with ASD (one 10 years old and one 11 years old) to use *multi-step requests* as well as *social communication*. The social communication skills involved *hello* and *bye-bye*, and indicators of politeness such as *thank you* and *please* as well as *yes* vs. *no*. The multi-step request involved an additional icon for *I want*. The two individuals had been involved in prior work by the same investigation team aiming to compare three modality types. The 11 years old used "picture exchange" to request four items while the

other youngster seems to have learned 4 or 5 requests in this same modality. The article indicated some effort to demonstrate conditional discrimination regarding icons associated with preferred items (though they described a compliance model, not their stated correspondence checks). From the author's Table 1, it was noted that the instruction for using the *hello* icon was "Say hello." Similarly, the instruction for using *Thank you Bye-bye* was "Say thank you and good-bye." Nothing in the article suggested any attempt was made to teach discrimination of any of these icons. Even the use of *I want* was at best positionally learned, not discriminated as in "I want" vs. "I see." There was no description of how *yes/no* was taught nor was any evidence provided that these were discriminated by actual preference. There was no description that *please* was used to indicate politeness and not used when a request was less formal (i.e., polite—"Please pass the butter" vs. direct—"Throw the ball to me!").

When publications are read, rational expectations based upon common observations and awareness of general knowledge about language development should not be abandoned. Assume that someone reports that their very young, typically developing child currently used four or five words. The next day (or within a few days), that person reports that her child now says, "Hello. I want a toy, please. Thank you. Bye-bye." Such a report would be viewed incredulously as such an exponential change in language is not possible. The reacting to such a change involving adolescents with ASD should not be less incredulous. Perhaps these users acquired additional requests and perhaps they learned to place a distinct icon, which we—as listeners—view as "I want" next to the requested item. Even within the PECS protocol, in phase IV, when users are taught to use an "I want" icon, at that point in the training sequence that icon has no *meaning*. It cannot have meaning until it is properly used in comparison with other *sentence starters* such as "I see" or "I have." Nothing in this study suggested that these users acquired discrimination of *hello* vs. *bye-bye*, *yes* vs. *no*, *please* vs. *direct action*, or *thank you* vs. *direct action.* Equally importantly, there was no demonstration that any of these supposed indicators of multi-step and social communication occurred under the control of appropriate social and communicative contingencies. Focusing on the manipulation of a picture (in any medium) without regard to "under what condition" can readily lead to gross overestimations of skill levels. For many decades, technology has permitted activating a single switch/button of a device that results in auditory stimuli that listeners react to as "a voice speaking a language." The activation itself does not assure that language/communication has been produced. It is the conditions under which the device is used that permits attributing the sounds as *communication*.

These studies can be contrasted with several that carefully attended to issues related to the identification of controlling variables as well as clear descriptions of training protocols. In a series of studies, Rehfeldt and colleagues demonstrated the effectiveness of PECS training with adults with severe disabilities (though not ASD). Several involved teaching individuals to request items that were needed to complete a chained task but were out-of-sight (Chambers and Rehfeldt 2003; Rosales and Rehfeldt 2007; Ziomek and Rehfeldt 2008). Furthermore, the study by Rosales and Rehfeldt (2007) used a relational frame approach to training and found responses had generalized to derive requests (i.e., requests not directly reinforced during training) via text or speech while the Ziomek and Rehfeldt (2008) study showed some generalization to tacts and intraverbals. These studies demonstrated that adults with severe disabilities can learn complex communication repertoires, although with initially small repertoires. All of these studies involved following the PECS training protocol with clear fidelity.

Another study involving adults was published by Conklin and Mayer (2010) who studied teaching the PECS protocol to three adults with severe disabilities, although none displayed ASD. All acquired the initial exchange rapidly and learned to discriminate pictures. One of the three completed all of the phases of PECS, including commenting. All three also were observed to have decreased various challenging behaviors across their acquisition of functional communication skills. Fidelity measures indicated high fidelity regarding the implementation of the PECS protocol. This publication appears to be a rare example of functional communication with adults with severe disability leading to skills beyond simple requests for preferred items with single pictures.

The publications by Rehfeldt and colleagues and by Conkling and Mayer regarding successful acquisition of functional communication after using the PECS protocol were implemented with adults with severe disabilities, though not with ASD. Earlier, it was noted that two publications involving PECS with adolescents with ASD demonstrated substantial communication gains. It seems reasonable to presume that strategies found effective with adults with severe disabilities also would work for adults with ASD, although research confirmation must still be demonstrated.

Suggested Guidelines

The discussion of the literature regarding the use of various strategies to teach functional communication via any modality to adults with ASD points out that there are very few well-controlled studies in support of such strategies. Therefore, it is incumbent upon practitioners to design methods that assure that an individual being taught to use either speech or an AAC approach demonstrates specific skills.

First, it is central to the definition of functional communication that the communicative partner (i.e., the listener) is demonstrated to control the communicative response. That

is, when adult is described as using an SGD to engage in communication, then whatever response is used to define *communicate*, such as "pushes a specific button," occurs in the presence of the partner but rarely in the absence of the partner. When the rates of button pushes—and thus auditory activation—is equal when the partner is present versus absent, then it is likely that the device is functioning as a *toy* not a communication device.

In order for someone to be said to be communicating via an SGD, there must be evidence that the sound from the device is truly communicative, rather than just noise. To test the role of the *voice* the device can simply be muted or the volume turned down until it is inaudible. Should the user continue to press buttons or images at the same rate whether or not the sound is emitted, then it can be assumed that the *voice* is not functionally relevant to the user. However, if it is observed that the interaction is significantly disrupted, then an assumption can be safely made that the *voice* is truly serving a communicative function. Such a test condition should be limited in scope and agreed to by relevant parties.

It also is important to test and identify the conditions which govern the communication responses, whatever the modality. Earlier, it was noted that various conditions relate to whether or not a response is *spontaneous*, and such conditions should be tested. When an adult uses a device when told to do so (or reminded "Where are your pictures?" or "Find the apple button"), then device use should be tested when no potential communicative partner says (or indicates) anything. This test for spontaneity should be used for both requests and comments.

In terms of individual pictures, each *word* must involve clear discrimination or contrast from other *words*. That is, a unit has meaning only when pushing a button, pointing to a picture, exchanging a picture, forming a sign, or saying a word involves a demonstration that a contrasting picture/sign/word is used under a specific different condition. Communicating involving *blue* only has meaning when it is used in association with blue items (or words) while *red* is used in association with red items/words. Essentially, if everything is *blue*, then nothing is blue. Furthermore, a correspondence check should be performed for various requests and comments to ensure conditional discrimination. For example, when someone activates an SGD that *says*, *I want a banana*, then the communicative partner should offer bananas and other favorite fruits (without saying or indicating *banana*) and observe whether the user takes the banana, thus demonstrating correspondence between what was taken and what was requested. This type of test is essential independent of the modality. To assume that when an adult touches the banana picture he *must mean* the banana does not respect that this user, or anyone, might have made an error.

In a related manner, when a true *sentence* is formed, then there must be a demonstration that each individual word in the sentence has a verifiable contrast/discrimination. Technology has long been able to have the activation of a single button/switch lead to a complex auditory output that skilled listeners respond to as *speech*. To attribute each word in the sentence to the individual who activates the mechanism requires extensive demonstration regarding the discriminative control of each component in the frame. The best way to honor individuals with ASD or other severe disabilities is to devote great effort into demonstrating under what conditions that individual engages in functional communication.

When a user constructs two or more words to form a sentence, each word must be demonstrated to be under appropriate control. Starting the sentence should be under appropriate conditions regarding requesting, commenting, answering questions, or responding to what someone else has communicated. Once the sentence begins, each word should be controlled either by the immediate situation or by the prior word rather than the actions of the communicative partner. For example, someone asks a teenager, "What do you want?" and the teenager constructs the sentence, *I want to play a video game on my phone* without any further action by the partner. However, it is possible that the user *constructed* the sentence in the following manner: after asking the question, the partner points to an *I want* icon, followed by the teenager pointing to the selected image, then the partner points to the *play* icon, followed by compliance, and then, the *video game* icon, and so on. In this situation, the sentence should not be attributed to the teenager because no response depended upon the user's other responses. This sequence is a set or series of discrete responses, not a chained compilation of a sentence. The same analysis would be true for all modalities.

Within any lesson that involves prompting in any manner, a clear description of the prompt elimination strategy and the resulting cue must be specified so that others can replicate the strategy. It is crucial to remember that any form of help regarding the communicative response functions as a prompt, regardless of the *intent* of the teacher. Therefore, when someone suggests that their physical guidance is not a prompt but rather *support* observers should openly challenge the assertion. Only direct testing of the role of such guidance led to the debunking of strategies such as facilitated communication (see Travers, Tincani, Thompson and Simpson, 2016, for a comparison between facilitated communication and PECS).

Adolescents and adults with ASD have been shown to acquire a variety of functional skills, including vocational and other community-based skills and various domestic-based skills (see Tincani and Bondy 2014, for a compendium of examples). Many adolescents and adults with ASD would benefit by acquiring or improving functional communication skills. A search of the extant literature focusing upon the acquisition of a robust and diverse repertoire of functional communication skills yields few examples with adolescents and even fewer with adults.

Independent of modality, there appear to be no clear examples of large numbers of adolescents or adults with ASD who acquire large communication repertoire with multiple functions using complex arrangements. A few studies have demonstrated with adolescents with ASD the acquisition of the variety of skills taught within the PECS protocol, including requests, responses to simple questions, comments, and use of attributes to enhance both requests and comments with overall modestly sized repertoires. However, the only examples of adults acquiring the full range of skills within the PECS protocol involved individuals with severe disability, not ASD per se. There has been a virtual explosion of studies involving the use of a variety of SGDs using a wide range of teaching strategies. However, the magnitude and clinical significance of the outcomes has been extremely limited in scope. Typically, adolescents and adults with ASD acquire a very small array of requests. Reviewing the SGD literature with children with ASD does not substantially change that conclusion. A review by Lancioni and associates in 2007 examined almost 20 publications involving SGDs but the range of pictures acquired was 1 to 8 with a mean of three per study. The more recent review by Gilroy et al. (2017) noted that 90% of SGD publications narrowly focused on requesting with very few demonstrations of complex communication functions.

What remains challenging is separating the role of teaching strategies from modalities. It is possible to use poorly designed strategies with any modality, confounding any analysis of efficacy by modality. There are behavioral differences between pointing to a picture versus giving the picture to a communication partner. The exchange guarantees interaction with an audience while pointing (even to an icon that activates an audio output) does not. Of course, it is possible that the point serves a communicative function, but it is incumbent upon others to verify the conditions under which the act occurs. Some research with SGDs has attempted to follow the PECS protocol, even as far as attempting to teach users (children) to exchange a smart tablet with a communicative partner (see Boesch et al. 2013, as an example). Whether such strategies will prove helpful for adolescent and adults with ASD remains to be tested.

When adolescent or adults with ASD lack functional communication skills, using the PECS protocol would be encouraged as an evidence-based strategy. The use of SGDs with this population may be guided by recommendations offered by Frost and McGowan (2011, 2012) to describe effective transitions from PECS to SGDs. These recommendations were independent of a user's age. The guidelines involved examining the size and complexity of the current picture repertoire and emphasized our ethical obligation to assure that no skills are lost during any transition between modalities.

Hopefully, research will soon be forthcoming that demonstrates adolescent and adults with ASD acquiring large repertoires of multi-function communication using combinations of units. Continued efforts that focus on a small number of such individuals acquiring very small repertoires limited to requesting even with new technology is not likely to lead to substantial improvements in socially significant skill acquisition, which is one of the hallmark goals of our field.

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