Chapter 9
Augmentative and Alternative Communication Applications for Persons with ASD and Complex Communication Needs

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Abstract This chapter provides an introduction to the concepts of intentional and non-intentional communicative acts as they relate to the emergence of a learner's attempts to influence others. In addition, critical terminologies related to these concepts are defined. Second, this chapter describes the variables involved in the implementation of augmentative communication systems that can greatly expand contexts for independent social interaction. Specifically, augmentative and alternative communication (AAC) is defined and specific types of AAC (i.e., aided and unaided) are described. Third, topics related to the selection of communicative mode(s), functions, and symbols to teach during the early stages of intervention are discussed. Fourth, the authors address whether implementing an augmentative communication system is likely to have a negative or positive effect on the probability of acquiring other communicative behavior, specifically vocal mode communication. Additionally, the authors discuss potential collateral gains that have been reported in learners who were taught to use augmentative communication systems. Fifth, the authors address instructional formats that are available to communication interventionists along with the need to consider overall intervention intensity and specific intervention parameters of dosage when selecting a format. Last, authors examine generalization of AAC responding and discuss strategies to enhance it.

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D. Keen et al. (eds.), *Prelinguistic and Minimally Verbal Communicators on the Autism Spectrum*, DOI 10.1007/978-981-10-0713-2_9

Nearly all learners engage in communication depending on how one defines it. ***Communicative intent*** involves the emission of an act that is intended to influence the behavior of another individual by expressing a purpose for producing the act. ***Communicative means*** describes the form that a communicative act assumes (spoken [and/or] gestural [and/or] graphic). The learner's choice of a communicative means is based on the matching law (Herrnstein, 1961) which suggests that an individual's response rate will be proportionate to the immediacy amount/duration of positive reinforcement, the response effort to gain reinforcement, and the practical operationalized parameters of "response efficiency". Among beginning communicators selecting a more conventional communicative alternative for an existing communicative means requires the best possible match between the purpose of the existing communicative act and the communicative act chosen to replace it. In teaching a communicative alternative it is important that the learner either already attempts to influence the actions of others or can be taught to do so. Thus the first section of this chapter addresses the emergence of a learner's attempts to influence others and the range of communicative acts that can be acquired.

9.1 Events Leading to the Learner's Attempts to Influence Others (Distinguishing Between Non-Intentional and Intentional Communicative Acts)

The term ***communicative function*** is used often in discussing an individual's initial communicative repertoire (Carr & Durand, 1985; Wetherby, Reichle, & Pierce, 1998). Communicative function describes the outcome of behavior produced that actually influences the actions of others. When an individual repeatedly produces a particular behavior in the same context that in turn leads to specific outcomes (e.g. to gain attention, gain access to a desired object/event or escape demands), it becomes increasingly clear that he/she is seeking to achieve an outcome associated with the act. However, it does not follow that all communicative functions are communicative intentions. The two terms refer to somewhat different phenomena.

Bates (1979) described communicative intentionality as "signaling behavior in which the sender is aware apriori of the effect that a signal will have on his listener" (p. 36). Intentionality must be inferred. Further, there is a difference between ***intentional behavior*** and ***intentional communicative behavior*** (Reichle & Brady, 2012). For example, a 7-month-old might attempt to obtain a toy on a shelf by reaching for it (intentional behavior). However, after struggling and being unable to reach the toy, he may not realize that an adult can be used as an agent to gain access (this would be a potential indicator of a failure to demonstrate intentional communicative behavior).

Communicative function describes the effect that a learner's act has on others. For example, in response to crying, a parent may provide a nutriment. If hunger

around a typical feeding time resulted in crying and if a parent fed the child at this time, the probability of crying would increase around mealtime. As a result one might conclude that the function of the learner's behavior is to obtain a desired object/event (e.g., food). However, in this example, the child's behavior may not be produced to influence a listener, if it is guided more by the learner's schedule and less as a function of an available listener. Wetherby and Prizant (1989a, 1989b) suggested criteria to assist in determining whether a learner's communicative behavior is intentional. As Reichle and Brady (2012) observed, although specific criteria employed have differed (cf. Harding & Golinkoff, 1979; McLean, McLean, Brady, & Etter, 1991; Wetherby & Prizant, 1989a, 1989b), several often described include: (a) alternating eye gaze between object/event of interest and one's communicative partner, (b) persistent signaling until a goal is accomplished or failure indicated, (c) waiting for a response from a listener after an initial communicative act has been produced, (d) changing the signal quality until the goal has been met (e.g., speaking louder), and (e) ritualizing or conventionalizing communicative forms (e.g., doing what one's older brother does to obtain a desired item).

Augmentative communication strategies can be implemented with learners who do not emit intentional communicative acts. For example, Calculator (2002) taught parents of nine children with severe neurodevelopmental disabilities, including severe to profound intellectual delays, to enhance natural gestures (ENGs). ENGs were defined as gestures comprised of motor components already in the child's repertoire that do not rely on physical contact with a referent and are easily understood by familiar communication partners. An example of an ENG might involve the hand movement made to bring a cup to one's mouth and drink, when made in the absence of the cup. The program involved coaching parents in natural environments. The dependent measure was a parent self-evaluation rather than specific dependent measures on child performance. A questionnaire, Enhanced Natural Gestures-Acceptability Rating Form (ENG-ARF), sampled parents' perceptions about the acceptability and feasibility of the ENG training procedures. With few exceptions, parents described this method as acceptable, effective, reasonable, and easy to teach others, with minor negative consequences and side effects.

We hypothesize that it is important to make the distinction between intentional and non-intentional communicative acts (see Reichle & Brady, 2012, for a more complete discussion). We believe that it is likely that a greater number of instructional opportunities will be required by a learner who is not yet producing intentional, but more idiosyncratic, communicative acts.

In the paragraphs that follow we will describe the variables involved in the implementation of augmentative communication systems that can greatly expand contexts for independent social interaction. We begin with a definition of augmentative and alternative communicative communication. This will be followed by topics that address the selection of communicative mode(s), functions, and symbols to teach during the early stages of intervention. Next, we will address whether implementing an augmentative communication system is likely to have a negative or positive effect on the probability of acquiring other communicative behavior

(specifically vocal mode communication). Related to this topic, we will discuss potential collateral gains that have been reported in learners who were taught to use augmentative communication systems. Finally, we address instructional formats that are available to communication interventionists, along with the need to consider treatment dosage in selecting a format. Finally we examine generalization and strategies to enhance it.

9.2 Defining Augmentative and Alternative Communication

Augmentative and alternative communication (AAC) includes any system of communication that supplements (augments) or replaces (alternative) conventional speech in providing support for an individual who, due to a disability that has resulted in a permanent or temporary condition, has a complex communication need (CCN) (Romski & Sevcik, 1997). There are two main categories of AAC, *aided* and *unaided*. Aided AAC includes systems that require equipment (Johnston, Reichle, Feeley, & Jones, 2012; Light, Roberts, Dimarco, & Greiner, 1998). Some examples include written or typed messages, pictures in which the learner points to images to create messages that may be displayed non-electronically in a notebook or on a board or, alternatively, on a high-tech display that might involve the use of a smart phone, tablet, or laptop application with dedicated software. Unaided AAC does not require external equipment. Examples include sign language (e.g., American Sign Language), sign systems (e.g., Signed English), and the informal use of gestures (e.g., pointing) and nonverbal communication (e.g., raising eyebrow – see Johnston et al., 2012).

Distinct advantages have been reported for both aided and unaided communication systems. Aided AAC may be advantageous for individuals who have difficulties with recall memory, more abstract language, or fine motor control in that they can be designed to offer concrete symbols that are less transient than speech or gesture, and they can provide the opportunity to choose symbols via recognition memory rather than requiring recall (with rudimentary single-page displays or with a system that minimizes the need for multi-page navigation skills). Additionally, aided systems can be configured such that they have relatively modest requirements for motor control such as an eye-tracking switch (see Johnston et al., 2012, for further description). Sign languages and sign systems cannot claim these advantages (Ganz et al., 2012; Johnston et al., 2012). Unaided AAC applications (particularly signs), on the other hand, may be more suitable for individuals who have strong recall memory, a better grasp of learning more abstract symbols, intact fine motor skills, and access to communicative partners who readily understand signs (Johnston et al., 2012; Rotholz, Berkowitz, & Burberry, 1989). Advantages of unaided AAC include potentially immediate access to unlimited vocabulary, portability, and speed of production (Johnston et al., 2012).

9.3 Describing Aided Augmentative and Alternative Communication Options

9.3.1 Low-Tech Options

Low-tech aided AAC systems include any non-electronic aided systems used by people with CCN to communicate (Ganz, Earles-Vollrath, et al., 2012; also see Johnston et al., 2012). A range of low-tech AAC options have been investigated and recommended for use with persons with autism spectrum disorder (ASD) who experience a CCN. These options largely fall into two categories: non-exchange-based picture-photograph-product logo or exchange-based systems using the same types of symbols (Ganz, 2014). Non-exchange-based systems involve providing a person with CCN with a page or board with pictures or letters with which the individual communicates messages of varied lengths. In exchange-based systems, the person with a CCN is taught to exchange picture cards with a communicative partner for expressive communication (e.g., Picture Exchange Communication System [PECS] – Bondy & Frost, 1994). Exchange programs have the features of teaching the learner to locate a communicative partner prior to emitting a message. Additionally, they make it easy for the interventionist to randomize symbol choices during the early phases of instruction to ensure that the learner is not choosing symbols based on their position rather than their visual features (Reichle, York, & Sigafoos, 1991).

In using a low-tech system, both exchange and non-exchange can involve the use of a direct selection technique where the learner chooses a specific symbol without any device or partner assistance. However, non-exchange (those where the graphic symbols are in a fixed position on the display) low-tech systems have the advantage of permitting the use of a scanning technique to select specific symbols in which a communicative partner offers symbol choices sequentially and the aided system user signals (e.g., head nod, eye blink) when the partner has offered the symbol that the individual wishes to select.

In general, aided AAC has been considered to be moderately to very effective for persons with ASD (Ganz, Earles-Vollrath, et al., 2012) and also among learners with moderate and severe intellectual delay (Johnston et al., 2012). When skills are broken down by domain, aided AAC has been shown to be particularly effective at improving communication, but somewhat less effective with social skills such as social initiation and responsiveness (Ganz, Earles-Vollrath, et al., 2012). One exchange-based system, the PECS (Frost & Bondy, 2002), has a substantial base of experimental support for use with people with ASD. For instance, PECS has been found to have a substantial impact on communication outcomes with the caveat that it has not been demonstrated to be as effective as functional communication training (FCT) for individuals who engage in problem behavior (Ganz, Rispoli, Mason, & Hong, 2014). This may be because in the initial phases of PECS, the learner must travel to a listener requiring a greater delay in time between symbol selection and the delivery of desired outcome. Thus, reinforcement may not be as

immediate. This, in turn, allows more time for existing problem behavior to continue to be emitted. Thus, an exchange-based system may have greater constraints on the response efficiency parameter of immediacy of reinforcement (Horner & Day, 1991). Additionally, unlike FCT, PECS does not require the implementation of a functional behavioral assessment to identify the function of problem behavior. Thus, it is less likely that functional equivalence between the problem behavior and the new communicative alternative is established prior to program implementation. Some learners may benefit from more sophisticated graphic mode displays that have been described as mid- to high-tech speech generating devices.

9.3.2 Aided AAC: Mid- to High-Tech Options

Mid- and high-tech AAC options include any electronic devices used to augment or replace conventional speech (Johnston et al., 2012). Typically, devices that generate speech are described as higher-tech speech generating devices (SGDs) that produce human recorded digitized speech and/or synthetic speech when activated (McNaughton & Light, 2013; Son, Sigafoos, O'Reilly, & Lancioni, 2006). Although there is clearly a continuum from mid- to high-tech devices, some examples of mid-tech devices include older SGDs, such as the BIGmack® and the Tech Speak®, and Go Talk®. These devices range from one to approximately 128 messages or keys that each contains a different recorded message. Some devices requiring human recorded speech allow only a brief number of seconds to record a message on each symbol; others allow the user to allocate the total number of seconds however they wish (for example one symbol could have a minute of recorded message while another might have only 5 s). Having the flexibility to individualize the number of seconds per message affords an advantage with learners who may wish to participate in "show and tell" or "sharing activities with longer narratives".

Some mid-tech devices use paper overlays with each overlay corresponding to a different page of programmable symbols. Each of these different levels can be selected by adjusting a switch to move across levels (electronic pages). Although this type of mid-tech communicative device typically is less costly, it tends to require greater physical effort than using higher-tech devices that allow an automatic linking of one symbol to another across electronic pages. On some mid-tech devices, the user's partner must switch between levels of recorded message using a switch on the back of the device. On others, a row of symbols on the main page of the device can link to another page if the learner selects the symbol. For many learners, regardless of the option, their communicative partner must change the overlay. Usually, mid-tech devices use digitized speech.

As mentioned earlier, high-tech AAC systems often combine digitized and synthesized options so that sound effects and singing can be easily displayed via digitized recordings while text-to-speech and prediction applications can be readily

utilized with synthesized speech, affording the learner who is literate or partially literate to construct his/her own message. Many high-tech aided communicative options are tablet-sized computers and may be either dedicated AAC devices or may be applications, or "apps," within multi-purpose mobile technology (McNaughton & Light, 2013; Shane et al., 2015). Dynamic AAC software and apps allow for significant flexibility in selection and organization of vocabulary, display design, and navigation between pages. Examples of dedicated devices include the DynaVox® T-Series and Prentke Romich products, such as the Accent™-M Group of products. Current AAC apps include Proloquo2Go®, GoTalk NOW®, and Dynavox Compass™.

Virtually all high-tech speech-generating devices allow any given symbol to be linked to any other page. Additionally, high-tech systems permit *prediction* to lessen keystrokes required for selection. Prediction provides the learner with additional visual cues to signal possible or appropriate available choices. For example, when beginning an utterance, only the symbols that are used to begin a turn are available. Then, once an initial selection is made, only those symbols that are paired with the first choice are offered, thus decreasing the field of available options, and narrowing the field of choice. Prediction also permits *pronunciation exceptions* so that a spoken message will be pronounced correctly but will also be printed correctly via traditional orthography. Further, many high-tech systems permit communication via email and have environmental control features to assist the learner beyond communication. With respect to apps, emerging research has demonstrated their efficacy in teaching a number of communication skills to people with ASD (Ganz, Boles, Goodwyn, & Flores, 2014; Kagohara et al., 2013; Murdock, Ganz, & Crittenden, 2013).

Some research syntheses have concluded that high-tech aided AAC can be highly effective, while others have found little difference in effectiveness between high- and low-tech aided AAC. Thus, more research remains to be done to assist with selection of AAC modes given particular individual characteristics (Ganz, 2014; Lancioni et al., 2007). However, as high-tech AAC becomes increasingly affordable and portable, such systems may become increasingly preferred (Ganz, 2014; Shane, Blackstone, Vanderheiden, Williams, & DeRuyter, 2012). Given its recency, it is likely that this area of research will greatly expand over the next decade.

Traditional AAC systems, both low-tech and high-tech, display available vocabulary in a grid format, in which each language concept is represented by separate symbols in "boxes" organized in rows and columns. An alternative approach that may be appropriate for individuals who are functioning at beginning stages of communication is the use of visual scene displays (VSD). In this approach, vocabulary is embedded under "hot spots" in a picture or photograph that depicts a situation, place, or experience that is familiar to the learner. In this approach language is presented within a meaningful context, while meaning is derived from the entire scene (Drager, Light, Speltz, Fallon, & Jeffries, 2003). For typically developing young children, toddlers at the age of 2½ were more accurate in locating vocabulary using VSDs than grid displays (Drager et al., 2003), while 4- and

5-year-olds performed with similar accuracy when locating vocabulary using VSDs or grid displays (Light et al., 2004). This suggests that VSDs may be better suited than grid displays for infants, toddlers, younger preschoolers, and other beginning communicators (under age 4–5 years developmentally).

The majority of published research using VSDs is with typically developing children; there are very few studies involving individuals with ASD. Gevarter et al. (2013) compared three different AAC display systems in teaching requesting (snack, drink, and/or toys) to 3-year-old children with ASD: grid-based, scene-based, and a hybrid display (that involved a combination of a grid display and VSD display features). Two of the three participants reached mastery with the scene-based condition that appeared to be more advantageous. The display type had no effect on the third participant, who reached mastery on all three types in a similar number of sessions. However, in this study the "scenes" carried very little contextual information (which is purported to be a primary advantage of VSD displays), and were similar to photographs of real objects in isolation.

Ganz, Hong, Gilliland, Morin, and Svenkerud (2015) investigated the use of a high-tech system with VSDs versus a communication book with an exchange-based system with two 5-year-olds with ASD, using an alternating treatments design. One participant spontaneously commented and responded to questions more often in the VSD sessions, while the other did not use either form of AAC. This suggests that individual differences may have played a role in the children's performance. It is also impossible to parse the effects of the use of VSDs from the speech output available on the high-tech system. But for at least one of the children, the system using VSDs appeared to have a positive effect on spontaneous communication.

Finally, Drager et al. (2014) investigated the effect of a high-tech system that included VSDs and just-in-time programming (fast "in the moment" import of photos as VSDs and programming of vocabulary within the VSD) on communication turns with nine school-age children and adolescents. Three of the participants had a diagnosis of ASD (an 8-, 16-, and 20-year-old). The introduction of the high-tech AAC system using VSDs was effective in increasing the number of communicative turns for all nine participants. Any comparison of VSD and grid displays is likely to be influenced by prior intervention history. For example, if a learner had a prior history with PECS, which utilizes a grid display, it is reasonable to hypothesize that the learner may perform better with that type of a display when compared with performance on a VSD.

Regardless of display option, dynamic display systems require strategies to search for and locate symbols across pages. Using a high-tech system is essentially a matching-to-sample task, requiring the learner to think about a referent, and then matching that referent to the symbol on the device (Reichle & Drager, 2010). Several strategies have been recommended to establish beginning matching skills, including stimulus control procedures which establish successful matching to sample under simple and obvious conditions, and then subsequently maintaining the responses under more challenging conditions. These procedures have been shown to be effective in teaching children to move from more to less iconic symbols

(e.g., photographs to line drawings – see Carr, Wilkinson, Blackman, & McIlvane, 2000; Serna, Jeffery, & Stoddard, 1998).

Use of a dynamic display also requires being able to visually scan a page of symbols, make a decision about whether the desired symbol is present, and if necessary navigate to another page to continue searching for the symbol. In addition, it often becomes necessary to search for a target symbol in the absence of an external physical referent (e.g., Johnston et al., 2012; Romski, Sevcik, & Pate, 1988). For example, a learner may wish to request the presence of a favorite teacher who is not currently in the room. To search for a symbol to accomplish this request, the learner must keep the target symbol in mind while (a) inhibiting attention to the non-target symbols that appear, and (b) recalling on which page the desired symbol is located (Reichle & Drager, 2010). This situation is similar to a delayed matching-to-sample task. Research is lacking on strategies to teach learners to successfully navigate across pages. Reichle and Drager, however, have hypothesized about several display approaches that may facilitate searching, such as the use of zoom or magnification, "popups", scrolling, or menus that border the page, eliminating or facilitating the need to navigate without learning a search path.

The past 10 years have spawned a plethora of aided communication systems apps that are most often used with tablets or smartphones. Emerging research has demonstrated their efficacy in teaching a number of communication skills to people with ASD (Ganz, Boles, et al., 2014; Kagohara et al., 2013; Murdock et al., 2013). However, a careful evaluation of most of these applications is lacking.

9.4 Describing Unaided Augmentative and Alternative Communication Options

Unaided AAC includes both representational and non-representational gestures and signs. Representational unaided AAC includes manual sign languages/systems (Goldstein, 2002). They are representational in that they correspond to a particular referent, action, attribute, location, and so on that is discriminable from another symbol within or across a class. In the United States, the primary systems used are American Sign Language (ASL) Signed Exact English, and variations of Signed Exact English; unlike ASL, sign systems such as Signed English closely match some aspects of spoken English. Thus such sign systems are not distinct languages like ASL. Non-representational unaided AAC includes nonverbal communication, such as deictic gestures (e.g., pointing, touching/proffering referents), facial expressions, and body language. Gestural symbols can be differentiated based on their handshape(s), movement pattern and location (and orientation) where they are produced with respect to the body.

Sign language/system implementation may be influenced by the more prevalent fine motor, memory, intellectual, and cognitive deficits (Mirenda, 2003; Worley & Matson, 2012) experienced in this population among AAC users. Most studies

teaching sign to this population have included small numbers of participants who learned a small number of signs (e.g., Bonvillian & Nelson, 1976; Carr, 1979; Remington & Clarke, 1983). Further, much of this literature consists of case studies (quasi-experimental) and anecdotal reports (Bonvillian & Nelson, 1976; Kee, Casey, Cea, Bicard, & Bicard, 2012; Konstantareas, Hunter, & Sloman, 1982). When participants have been given the choice between sign and aided AAC, children with ASD who experience CNN have more frequently chosen aided AAC (van der Meer, Sutherland, O'Reilly, Lancioni, & Sigafoos, 2012).

Increasingly, interventionists have come to recognize the advantages and disadvantages of the variety of the available AAC applications, and a strong case can be made for using a combination of aided and unaided communication modes. However, an essential consideration is determining how an interventionist, during the initial stages of intervention, can ensure from the learner's standpoint that the new AAC system will be maximally efficient. To that end, we will turn our attention to examples of decisions made by educational teams that influence efficiency.

Most learners rely on all three communicative modes (vocal, gestural, and graphic). However, during the early phases of intervention, the interventionist is trying to demonstrate the efficiency of more conventional communication to the learner. As such, it is important to maximize the efficiency of the communicative modes utilized. Therefore, it may be important to consider the ease with which the learner can acquire communicative forms from each of the three modes to determine, at least "in the short run", where to place intervention emphasis. Consequently, next we will address an experimentally based strategy that can assist interventionists in choosing which communicative mode(s) to emphasize at any given time.

9.5 Describing Modality Sampling and Multimodal AAC Use

Often, augmentative communication mode emphasis is not an empirically based decision. Our experiences suggest that most learners benefit from using multiple modes of communication. However, with learners who are demonstrating significant communicative delays, we believe that it is important to emphasize the communicative mode that will be most efficient from the learner's standpoint in any given communicative context. Modality sampling, discussed next, involves systematically implementing several communicative modes concurrently and examining features of learner performance to make decisions regarding which communicative modes to emphasize.

9.5.1 What Is Modality Sampling?

Modality sampling has been implemented to determine which communicative mode(s) to emphasize in AAC instruction (Johnston et al., 2012; Martin, Reichle, Dimian, & Chen, 2013; Reichle et al., 1991). Reichle et al. and Johnston et al. suggested that prior to emphasizing a particular communicative modality, it may be advantageous to expose learners to multiple modalities under at least "quasi-controlled" circumstances to determine whether a learner performs "better" with a particular communicative mode. "Better" can involve several different or a combination of dependent measures that include (a) teaching opportunities to criterion, (b) maintenance accuracy, (c) generalization performance, and (d) expressed preference, among others. This assessment strategy is a longitudinal assessment that allows a concurrent performance comparison of different communicative modes. Initial symbols to be taught are divided into three modes including gestural, graphic, and vocal. Dependent measures are obtained on performance in each mode (with symbols across modes equated for preference and frequency of use). Ideally, these comparisons are replicated several times with new vocabulary item sets.

The results of modality sampling may or may not clearly favor one communicative mode. Some communicative acts may be more efficient in one mode. For example, if one does not have impaired head movement, shaking one's head "no" could be a far more portable and immediate option to communicate a protest than a graphic symbol. Further, it is also possible that, in the future, a learner may become better equipped to acquire symbols in a communicative mode that were much more difficult for a learner earlier in his or her development. For example, the learner may not be vocally imitative during an initial modality sampling, but the development of this skill over time would facilitate proficiency in acquiring spoken word approximations. This makes repeated samplings important to ensure continued exposure to modes under "easy to learn" circumstances. We agree with the point of view that children who use multiple communicative modes tend to select the modes that are easiest to produce. Unfortunately, some children do not begin using multiple modes as a result of their particular disabilities. For these learners, more controlled sampling under more optimized learning conditions may be helpful in focusing intervention efforts in at least the short term. Executing an objective strategy to select a communicative mode to emphasize during the early phases of intervention has the potential to be very helpful with individuals who have a limited history of acquiring, at best, a modest conventional communicative repertoire. This approach may allow interventionists to optimally allocate valuable intervention resources and obtain maximal initial gain. Another advantage is that concurrent sampling of communicative modalities means that the interventionist does not need to wait for one mode to fail before implementing intervention in another communicative mode.

9.5.2 How Is Modality Sampling Implemented?

Typically, this assessment strategy involves first conducting a preference assessment (see Pace, Ivancic, Edwards, Iwata, & Page, 1985). This is followed by matching symbols, in a range of modes (e.g., verbal, gestural, pictorial) to the most preferred items (or items of similar preference). Next, concurrently, interventions are implemented in two or more communicative modes in order to compare any possible mode advantage with respect to acquisition, maintenance and/or generalization. Such an approach would be repeated with additional sets of symbols and in varied contexts to determine the most efficient communicative mode for that individual (Martin et al., 2013).

Depending on the context, it may be appropriate to provide a person with CCN with multiple communicative options (King & Fahsl, 2012). This strategy was referred to by Reichle et al. (1991) as duplicated communicative modes. Unfortunately, while a number of studies have investigated choice among AAC options for people with ASD (Ganz, Hong, & Goodwyn, 2013; McLay et al., 2015; van der Meer et al., 2012), relatively little work has been done investigating implementation of multiple communicative modes concurrently.

9.5.3 What Have Been the Outcomes of Modality Sampling?

Variations of modality sampling have been executed by a number of investigators (e.g., Adkins & Axelrod, 2001; Boesch, Wendt, Subramanian, & Hsu, 2013; Chambers & Rehfeldt, 2003; Hyppa Martin, Reichle, Dimian, & Chen, 2013; Tincani, 2004). In most cases, learner performance resulted in the selection of a primary mode for an individual participant based on acquisition performance.

Regardless of the communicative mode selected, an important aspect in making the case to the learner that new communicative forms are maximally efficient involves carefully selecting the communicative intent(s) or reasons that will be associated with symbols being taught. Next we address the selection of communicative intents to teach one that will be represented by the communicative means that have been chosen.

9.6 Selecting and Teaching Varied Communicative Intents

Wetherby and Prizant (1993) summarized three key categories of communicative functions, that is, reasons for which people communicate (also see Shumway & Wetherby, 2009). *Behavior regulation* includes communication intended to direct others' behaviors, such as by asking for something or asking someone to "stop." *Social interaction* includes communicating for the purpose of gaining or

maintaining someone's attention. *Joint attention* includes communication intended to direct someone's attention to information or items, or responding to others' bids for joint attention (see Shumway & Wetherby, 2009). Given the broad range of purposes for which humans communicate, it seems to be common sense that persons with CCN would be afforded the same opportunity. However, the majority of research on AAC with people with CCN has involved instruction in behavior regulation (particularly requesting skills), while other communicative functions, such as those that involve social interaction or joint attention, have been addressed more sparingly (Ganz, Earles-Vollrath, et al., 2012; Gevarter et al., 2013). This is not the case with learners acquiring AAC representing other disability groups (Ganz & Hong, 2014). Thus, this literature base would seem to be applicable to persons with CCN until more efficacy research has been conducted.

Daily routines and interactions must be observed to determine current communicative skills and functions that need to be taught in particular contexts (Hart & Risley, 1992; Reichle et al., 1991). For instance, a student may need a small range of different vocabulary items for use at his or her after-school job to ask for assistance or more materials or to greet customers. The same student may need a relatively large number of different vocabulary items to share information with their parent about their day. These situational vocabulary items will likely be needed to express a variety of communicative functions. Additionally, a range of conversational functions, including how to initiate, maintain (including repair), and terminate a conversational exchange will make it easier for the learner to socially interact with prospective communicative partners (Wetherby & Prutting, 1984). Lund and Light (2007) suggested teaching numerous communicative functions concurrently, whereas some AAC instructional protocols teach requesting skills exclusively for an extended period until requesting is mastered (Frost & Bondy, 2002). The selection of communicative intents to emphasize during initial instruction brings with it the need to select the type of communicative symbol. In our discussion we will emphasize decisions that must be made when a graphic communication mode has been selected.

9.7 Selecting Symbols to Match the Communicative Functions Being Taught

One important set of decisions to be made involves the selection of specific symbol forms to introduce to beginning communicators. This involves not only the physical symbol type (e.g., photo, line drawing, product logo) and the presence or absence of color but the specificity of the symbol as well (e.g., dog vs. collie, drink vs. orange juice).

9.7.1 What Is the Range of Symbol Types That Can Be Used in Aided Communication?

Within aided communication systems, interventionists have a wide variety of types of symbols from which to choose. These include pictures, photographs, line drawings, and product logos (all of which may be colored or black and white). Additionally, with higher technology style speech-generating devices, brief animated movies become an option. Reichle et al. (1991) suggested that sampling among these types in much the same way that one would implement modality sampling could be accomplished via simple discrimination tasks embedded during young children's daily routines to determine whether a particular symbol type was easier for a learner to discriminate.

Among symbol types, interventionists, often, have presumed that adding color to graphic symbols enhances their discriminability in that they are more representational (more closely resemble their referent). However, for individuals who engage in "stimulus over-selectivity" this may not be the case. Lovaas and Schreibman (1971) described stimulus over-selectivity as instances of overly selective attention to a portion of a more complex stimulus package. These investigators found that learners with ASD made selections based on a single stimulus component rather than attending to and using multiple features of the stimulus package that comprise an entity. Lovaas and Schreibman concluded that children with ASD exhibited overly selective attention. Since Lovaas and colleagues' original work, there has been increasing evidence that stimulus over-selectivity is positively correlated with chronological age (McHugh & Reed, 2007) as well as mental age (regardless of autism status [e.g., Rincover & Ducharme, 1987; Wilhelm & Lovaas, 1976]). Thus, while historically of particular interest to those serving persons with ASD, it is a topic that has much wider applicability in the establishment of early symbol discrimination skills.

9.7.2 Why Should Symbol Specificity Be Considered?

Symbol specificity is another area that has significant implications for the learner but has received relatively little attention to date. Specificity determines how much context and/or listener inference is needed to decipher a learner's message. It also determines the range of instructional contexts in which intervention opportunities can be embedded. At the most general level is a symbol such as "want" or "more". At the most explicit level is the symbol "Coca-Cola®". At an intermediate level of specificity, we have chosen "Cola." Assuming that an interventionist wishes to teach a learner a symbol when he wants to obtain a Coke® he/she could choose a symbol from a variety of specificity levels. We know that, initially, many typically developing learners tend to master symbols at an intermediate level of specificity ([i.e., "dog" rather than "animal" or "Collie"] Reichle et al., 1991). At slightly later

points in development, they tend to acquire more "superordinate" (animal) as well as "subordinate" (Collie) levels of symbols depending on the importance of specificity in any given context. Of course there are exceptions to this observation and we also are aware that developmental propensities can be helpful to the interventionist, but do not necessarily preclude considering other options.

There are a number of possible variables that can influence symbol specificity choices. One of the most general symbols that could be selected to communicate a request would be a symbol signifying "want." This general symbol offers several advantages for both learner and interventionist. First, the more general symbol "want" can fit a wide variety of objects and activities. With a more general symbol, the interventionist can create learning opportunities across a wide range of activities that occur throughout the day. Additionally, more general symbols can be associated with a wide array of objects. Consequently, there is an increase in the likelihood that an interventionist can implement teaching opportunities with highly preferred items/activities in a variety of occasions, thus taking advantage of the learner's motivation. Finally, in the case of teaching a symbol to be used as a request, a more general symbol precludes having to limit teaching opportunities as a result of satiation or a preference shift that is not directly due to satiation.

Unfortunately, there are some disadvantages associated with general symbols. General symbols tend to require a greater level of inference by social partners. For example, if one travels to Burger King® and approaches a clerk while touching a symbol "want", the clerk will not know enough about the learner's preferences to make a correct inference about the desired item. Therefore, general symbols make the learner far less independent in community environments. The advantages and disadvantages for explicit symbols are more or less the reciprocal of those described for general symbols.

In implementing an augmentative communication system regardless of communicative mode(s) chosen, parents are often concerned that doing so will negatively influence their child's acquisition of communication using speech. Although a reasonable concern, it appears to be unfounded. To the contrary, implementing an augmentative communication system may have a facilitative effect in collateral behavioral gains (see Millar, Light, & Schlosser, 2006).

9.8 Describing the Relationship Between AAC Implementation and Subsequent Speech Production and Comprehension of Speech Outcomes

In our experience, one concern often expressed by parents involves the fear that implementing an augmentative communication system with a learner who currently uses some spoken behavior (or may in the future acquire some speech) will impede speech development (Johnston et al., 2012; Romski & Sevcik, 2005). Existing evidence suggests that this does not appear to be the case. In fact, for a number of

learners participating in research, speech has been found to markedly improve during AAC instruction (Ganz, Earles-Vollrath, et al., 2012; Millar et al., 2006). Additionally, some (e.g., Harris & Reichle, 2004) have reported improvements in the comprehension of spoken vocabulary following the implementation of aided communication systems. Furthermore, the use of AAC modes has been reported to result in a reduction of problem behavior when implemented following a carefully implemented functional behavior assessment (Durand, 1999; Reichle & McComas, 2004; Walker & Snell, 2013; and numerous others).

When communication is made as efficient as possible, it may provide a learner with greater opportunities to devote attention and effort to other ongoing events at the time during which a communicative episode occurs. This, in turn, may enhance a learner's capacity to attend to and act on other simultaneously ongoing events. Thus, it is important to attempt to obtain a better understanding of collateral gains that may accrue during communicative opportunities.

9.8.1 How Might Collateral Gains in Speech Production and Speech Comprehension Be Facilitated?

Augmented input refers to a strategy wherein the partner uses AAC in conjunction with speech when interacting with the learner. Goossens (1989) first described an intervention system called aided language stimulation, in which the interventionist selects a graphic symbol paired with a verbal model during a naturalistic play activity. In doing so, an association can be made between the spoken word and the visual symbol. If the learner knows the symbol, this pairing will aid the learner in comprehension. If not, repeated pairings appear to provide (at least some learners) with the association needed to support learning (Harris & Reichle, 2004; Jones & Bailey-Orr, 2012; Wood, Lasker, Siegel-Causey, Beukelman, & Ball, 1998).

In addition to supplementing comprehension, providing a visual model (sign or graphic symbol) along with speech is likely to have further advantages for the learner. Modeling ensures that the communication mode for input is matched to the expected communication mode for output. That is, for most learners who use aided AAC, communicative input is spoken language, while communication output may consist of primarily aided AAC, resulting in a mismatch between these two modes. Typically developing children hear hundreds of thousands of models of spoken language before first words, while children who require AAC may see few, if any, models of symbol use as input before being expected to use the symbols as output. Arranging for the delivery of these models may also be an effective demonstration of use of the AAC system, reinforcing the acceptability of the communicative form and de-stigmatizing its use, while providing a natural demonstration of the effect of the symbolic communication in interactions (Romski & Sevcik, 1996), although there is no existing empirical evidence of these direct outcomes.

Although "aided language stimulation" (Goossens, 1989) is a term most commonly used to describe augmented input interventions, it originated as a highly structured intervention program. The System for Augmented Language (SAL) (Romski & Sevcik, 1996) is a similar modeling intervention. SAL differs from aided language stimulation in that it requires a speech-generating device (SGD) and the aided symbols are introduced gradually, beginning with one symbol. Goossens suggested beginning with at least 12 line-drawn symbols. However, all of the aided modeling interventions have the following components in common: (a) they are implemented during opportunities that arise out of natural contexts, (b) they augment the input the child receives, and (c) they employ modeling to expand vocabulary (Drager et al., 2006).

Aided modeling in combination with speech interventions has been successful with preschoolers, children, and adolescents with a range of disabilities, including moderate cognitive disabilities, Down syndrome, cerebral palsy, and apraxia (Binger & Light, 2007; Bruno & Trembath, 2006; Dada & Alant, 2009; Harris & Reichle, 2004), and adults with developmental disabilities (Beck, Stoner, & Dennis, 2009). The SAL (Romski & Sevcik, 1996) was implemented with children with a variety of diagnoses, including ASD, but it is impossible to isolate the effects of the intervention definitively for this population. However, a handful of investigators have examined these approaches specifically with children with ASD. Cafiero (2001) investigated the use of an aided modeling intervention, Natural Aided Language Stimulation, with an adolescent with autism and challenging behaviors in a middle school special education classroom. The intervention consisted of modeling and expanding upon any communicative overture (via signs, vocalizations, or symbols) by using a communication board. No direct instruction or prompting was provided. After the intervention, an increase in receptive and expressive vocabulary was noted, in addition to a decrease in challenging behaviors. Drager et al. (2006) investigated a modeling intervention with two preschoolers with ASD. These researchers implemented Aided Language Modeling ([ALM], a term used to differentiate the intervention from the more highly structured aided language stimulation, as coined by Goossens, 1989) in a preschool classroom during interactive play activities. Models were provided on language boards. For both children, symbol comprehension and symbol production increased upon introduction of the intervention, with production somewhat lagging behind comprehension.

While the evidence for aided modeling interventions with learners with ASD is meager to date, for learners who benefit from imitative models as a prompting strategy aided language modeling may be extremely useful. The available published research on aided modeling interventions with learners with ASD has been implemented using low technology communication boards and pictures. Romski and Sevcik (1993) suggested that speech output may aid in comprehension, and included use of an SGD as part of the SAL intervention. Brady (2000) noted that two 5-year-old children, one of whom had a diagnosis of ASD, demonstrated an increase in speech comprehension of objects via use of an SGD; the only time the children heard the names of the objects was with the speech output of the SGD.

Research is required to investigate whether the use of an SGD and speech output is facilitative of improved performance with these interventions with learners with ASD.

With respect to collateral decreases in problem behaviors as a result of teaching functionally equivalent communicative alternatives, it is important to note that functional communication training (FCT) has played an important role in providing an intervention approach in the collateral deceleration of problem behavior concurrent with the implementation of aided communication alternatives (Falcomata, Roane, Feeney, & Stephenson, 2010; O'Neill & Sweetland-Baker, 2001; Volkert, Lerman, Call, & Trosclair-Lasserre, 2009; Wacker et al., 2013; Wu, Mirenda, Wang, & Chen, 2010; see also Chap. 8, in this volume). Other intervention strategies such as the PECS have also resulted in collateral changes. However, as mentioned earlier, an FBA is an inherent part of FCT, but not for PECS. Thus, unless an FBA precedes PECS's implementation, obtaining a collateral deceleration in problem behavior may be less consistently achieved. An FBA involves assessing to identify the function, or purpose, of problem behavior prior to the development of a communication intervention to teach the client to engage in a communication behavior that results in access to an event that meets the client's desire or behavioral function (Durand & Merges, 2001).

By incorporating FCT into AAC intervention approaches, clients' needs are accounted for in regard to addressing problem behavior, which may result in easier access to community settings and decreases in stress to parents and service providers (Durand & Merges, 2001; Heath, Ganz, Parker, Burke, & Ninci, 2015). FCT implemented with aided AAC has been determined to be effective with people with ASD and other developmental disabilities (Heath et al., 2015). There is an overwhelming base of experimental evidence demonstrating the success of FCT in obtaining collateral effects including problem behavior reduction, play, increased academic engagement, and social outcomes (see Chap. 8 for a more detailed discussion of functional analysis of problem behavior and the replacement of problematic forms by teaching more appropriate communicative alternatives). Regardless of the intervention approach utilized, it is important to consider the instructional format that will be implemented. Next, we consider the continuum of general treatment approaches that are available to interventionists.

9.9 Describing Current Issues Involving AAC Instruction: Considering the Range of Discrete-Trial to Naturalistic Approaches

Our experience suggests that often there appears to be somewhat of a dichotomy between proponents of more discrete-trial intervention procedures and more diffusely implemented interventions with fewer controls placed on implementation procedures and the contexts in which intervention is implemented. We believe that

this dichotomy may not be in the learner's best interest. Clearly there are advantages and disadvantages to both approaches. Further, we believe that implementing one approach does not preclude considering or implementing the other as well.

9.9.1 Describing Discrete-Trial Approaches

AAC instructional practices range from adult-directed to learner-centered approaches. Adult-directed instruction often includes discrete-trial techniques that have a behavioral orientation. These strategies are among the best-researched interventions for people with ASD (e.g., Campbell, 2003; Eldevik et al., 2009; Howlin, Magiati, & Charman, 2009). Traditionally, discrete-trial interventions have been adult directed and highly structured with distractions minimized. Often, there is very little time between instructional opportunities. During the early phases of acquisition, each correct response is reinforced with a validated reinforcer. While internal validity is extremely high, it often creates limitations on external validity or generalization unless the interventionist takes special precautions to maximize generalization programming. Thus, given the evidence supporting these procedures (but also their limitations), they should be incorporated within more flexible, naturalistic instruction at the earliest possible point.

9.9.2 Describing Social Pragmatic (Naturalistic) Approaches

Naturalistic AAC interventions take place within contexts and for communication skills that are deemed to be socially valid and necessary for the particular clients and expand on previously-mastered communication skills (Binger & Light, 2007; Light, 1997; Ogletree, Davis, Hambrecht, & Phillips, 2012). Wetherby and Prizant (1993) characterized social pragmatic approaches to intervention as having characteristics that include: use of interactive-facilitative (shaping) strategies; interspersing directedness with following the child's lead; concurrently focusing on a variety of communicative functions in a variety of contexts; emphasis on using multiple communicative modes; use of "real" activities: and tendency to rely on developmental data on acquisition to guide patterns of content selection. Examples of more naturalistic approaches, such as aided language stimulation, allow for blending of behavioral techniques with the implementation of AAC interventions across natural settings and contexts and in combination with a more learner-centered approach. Naturalistic interventions fall under many names, including (but not limited to) milieu teaching, prelinguistic milieu, and enhanced milieu teaching. Several investigators have reported that the use of naturalistic AAC interventions with people with ASD have been effective (Dyches, 1998; McMillian, 2008).

Aided language stimulation, described earlier in this chapter, is one type of naturalistic approach for teaching communication skills (Jonsson, Kristoffersson, Ferm, & Thunberg, 2011). This approach and aided AAC modeling, a similar approach, involve selecting and combining AAC symbols, paired with verbal models (Binger & Light, 2007; Drager et al., 2006; Harris & Reichle, 2004). Additionally, the System for Augmenting Language (also described earlier) involves using an SGD, providing clients with feedback for their communicative attempts, aiding the client in expanding on his or her communication abilities, and providing positive reinforcement (see Romski & Sevcik, 1997).

9.9.3 Transitioning from Discrete-Trial Teaching to a Social Pragmatic Approach

We believe that the most naturalistic AAC interventions may involve a blended approach that incorporates behavioral strategies within natural contexts (Ganz & Hong, 2014), such as those identified as naturalistic developmental behavioral interventions (Schreibman et al., 2015). They may include the following components.

1. Implementation within settings in which AAC skills would naturally be used, such as natural routines and everyday activities, enabling generalization of skills into a range of settings (Light, 1997; Ogletree et al., 2012; Schreibman et al., 2015).
2. Child-led instructional practices, such that instructional episodes are based on activities that motivate the child/client and instruction begins once the client has approached the instructor or initiated communication (Schreibman et al., 2015).
3. Instructors' use of modeling instructional prompts, in much the way that typically developing children learn to communicate by first hearing others modeling language (Binger & Light, 2007).
4. Expansion of current, developmentally appropriate, socially important communication skills (e.g., verbal, AAC, gestures) and involving natural responses and rewards (e.g., naming a toy and receiving it to play).
5. Implementation of behavioral techniques including time delay, positive reinforcement, and prompting (Reichle, Drager, & Davis, 2002) in natural contexts.
6. Inclusion of natural communication partners as key interventionists within the context of active social engagement involving concrete people and items (Schreibman et al., 2015).

Although loosening instruction to include implementation in the most natural environments possible at the earliest possible point during intervention will help to facilitate generalization, there are explicit instructional frameworks that can also be implemented to enhance generalization among learners who have substantial learning challenges.

9.10 Maximizing Generalization and Conditional Use of Newly Established Communicative Alternatives

Conditional communication refers to maximizing a learner's ability to learn when and when not to use a particular communication skill being taught. Determining when to use a newly-taught skill requires that the learner extend the use of a new skill to situations that are still part of the stimulus class that fits the new vocabulary item (appropriate generalization). However, at the same time the learner must refrain from using a newly-acquired vocabulary item in a situation that is part of a different stimulus class. For example, if taught the word "ball", the learner should refer to a variety of objects (basketballs; tennis balls, foot balls) as balls, but should refrain from referring to an apple as a ball. Conditional communication is not only crucial for typically developing people: it is also important for individuals with moderate to severe developmental disabilities (Johnston et al., 2012). The concepts of generalization and conditional use function in opposition to each other to hone and sharpen the appropriate use of communication in context. They function much like opposing muscles that refine movement.

For instance, among individuals who utilize AAC that encompasses natural gestures, manual signs, picture-based communication board, and speech-generating devices, teaching the conditional use of communicative modes in the production of requests, rejections, or comments as a function of speaker and context variables has been advocated (Mirenda & Iacono, 2009; Sigafoos & Drasgow, 2001). For example, a sign which is quick to produce might be appropriate when one wants to communicate as fast as possible with someone who signs, but a slower to emit graphic symbol may be a better choice with a listener who does not sign. Increasingly, translational research has placed the burden on communicators with developmental disabilities to optimize communicative behavior for one's listener rather than relying on a communicative partner to accommodate the speaker (see Johnston et al., 2012). For example, a child who has learned how to request preferred items in which a large proportion of requests have been reinforced during acquisition may increasingly overgeneralize his/her emission of requests to situations in which: (a) the item may not always be readily available, (b) frequent consumption of the item may not be healthy or may interrupt other important daily living activities, (c) the high-rate requests may not be age appropriate; (d) the setting in which the request is made is inappropriate (e.g., asking for a soda during a church service), or (e) the individual who is the recipient of the request makes the request inappropriate (e.g., asking a stranger for money to operate a vending machine).

Existing evidence suggests that people with developmental disabilities who experience significant communicative challenges often have difficulty using newly acquired communicative behavior conditionally (Horner & Albin, 1988; Johnston et al., 2012; Reichle, Rogers, & Barrett, 1984). One challenge in learning to use communicative acts conditionally is that teaching exemplars must concurrently address both stimulus discrimination and stimulus generalization (Chen & Reichle, 2013). Stimulus discrimination refers to responding differently when a

relevant stimulus property is changed while stimulus generalization refers to responding in the same or a similar manner despite changes in irrelevant properties of a stimulus (Cheng, Spetch, & Johnston, 1997). For instance, when a child learns to request help when asked to open a well-tightened container (that he or she is not capable of opening), s/he must also continue to realize that s/he should continue to open a loosened container independently without requesting assistance. Further, the learner must see enough varying examples of each of these two conditions to make reasonable decisions about when to request and when to refrain from requesting.

Unfortunately, an extensive research array suggests that individuals with moderate to severe intellectual disabilities often have difficulty with stimulus generalization (e.g., Haring, 1988; Horner & Albin, 1988; Johnston et al., 2012; Joseph & Konrad, 2009; Turner, Dofny, & Dutka, 1994; Westling & Fox, 2009). Horner, Bellamy, and Colvin (1984) summarized generalization difficulties often exhibited by individuals with developmental disabilities. Some of those that are prevalent among persons with ASD include (a) irrelevant stimuli controlling the target response (e.g., referring to dogs as cats), (b) irrelevant stimuli controlling irrelevant responses (learner calls a Collie a dog but calls a small dog a cat), and (c) restricted stimulus control, meaning that a response that should be under the control of multiple relevant stimuli or multiple characteristics of a relevant stimulus is only controlled by a subset of those stimuli (calling a red apple an apple but not referring to a green apple as an apple). One framework of instruction, which is ideally suited to minimizing generalization errors while maximizing discrimination skills, is general-case instruction. Although it has been used in teaching persons with ASD somewhat sparingly, it represents an excellent instructional logic.

General-case instruction originated from Direct Instruction, a teaching technology founded by Engelmann, Becker, and Carnine (Becker & Engelmann, 1978; Carnine & Becker, 1982). Overall, general-case instruction emphasizes the concurrent implementation of both multiple positive (S+) and negative (S-) teaching exemplars to produce well-differentiated responses between the two types of exemplars and promote the generalization of learned skills to other untrained positive and negative exemplars. Positive teaching examples refer to any teaching example that should produce the target response, while negative exemplars refer to teaching examples that should NOT result in the learner producing the target response. General-case methodology has been utilized to teach many kinds of functional skills such as dressing skills (Day & Horner, 1986), personal hygiene (e.g., Stokes, Cameron, Dorsey, & Fleming 2004), street crossing (Horner, Jones, & Williams,, 1985), vending machine use (Sprague & Horner, 1984), telephone use (Horner, Williams, & Stevely, 1987), and fast food restaurant skills (Steere, Strauch, Powell, & Butterworth, 1990), as well as communication (e.g., Chadsey-Rusch, Drasgow, Reinoehl, Halle, & Collet-Klingenberg, 1993; Horner & Albin, 1988). Most of these studies demonstrated that general-case instruction is more effective in producing generalized effects than single-instance instruction (e.g., Chadsey-Rusch et al., 1993). Additionally, persons with significant developmental disabilities including ASD have often been a focus of general-case instructional strategy implementation.

Regardless of the approach selected to teach augmentative and alternative communication skills, an interventionist must grapple with how dense teaching opportunities must be to make it as easy as possible for any given learner to acquire a new skill. Determining this density falls under the domain of "treatment dosage" and represents an important factor that has been grossly under-addressed in the intervention literature (Parker-McGowan et al., 2014; Warren, Fey, & Yoder, 2007).

9.11 Considering the Importance of Treatment Dosage in Implementing Intervention

Regardless of whether a discrete-trial, more naturalistic, or blended approach is embraced by an interventionist, an important feature of any intervention for learners with significant developmental disabilities is: how much intervention is enough (Baker, 2012a, 2012b)? An inappropriate amount of intervention may have unintended consequences. If implemented more often than it needs to be, an intervention may provide no additional benefit and may divert valuable time that could be used to teach other essential skills. Alternatively, implementation with insufficient intensity may jeopardize skill acquisition, maintenance and generalization (Glogowska, Roulstone, Enderby, & Peters, 2000; Lincoln et al., 1984; Yeaton & Sechrest, 1981). Often overlearning or a more rigorous criterion for acquisition promotes enhanced generalization (see Reichle & Wacker, 2015). The selection of a particular intervention depends on a multitude of variables that include, but may not be limited to: (a) learner profile, (b) time-commitment required by the learner and his/her family, (c) skills targeted by the intervention, (d) setting where the intervention is delivered, and (e) a number of parameters of treatment intensity. Although each of these parameters is important, the focus of this portion of our discussion is treatment intensity and the influence that it may have on intervention outcomes.

Warren et al. (2007) described a framework that defined intervention intensity (see Table 1). They proposed that to accurately compare outcomes across interventions, there must be a common metric describing the intensity of an intervention that a learner experiences. Their framework included four quantitative intensity dimensions: (a) dose, (b) dose frequency, (c) total intervention duration, and (d) cumulative intervention intensity.

Determining the optimal intervention dosage of an AAC intervention is difficult because of the limited evidence on differential outcomes that may be associated with different dosage parameters (Baker, 2012a; Fey, Yoder, Warren, & Bredin-Oja, 2013; McGinty, Breit-Smith, Fan, Justice, & Kaderavek, 2011). The majority of available research has involved dose and dose frequency manipulations of interventions borne out of applied behavior analysis (e.g., Anderson, Avery, DiPietro, Edwards, & Christian, 1987; Birnbrauer & Leach, 1993; Eikeseth,

Table 1 Dosage parameters described by Warren et al. (2007)

Dimension of intensity	Warren et al. (2007)	Further operationalized definitions (Parker-McGowan et al., 2014)
Dose	The number of properly administrated teaching episodes during a single intervention session	Dose includes three subcomponents;
		(a) Average number of teaching episodes per intervention session
		(b) the length of the intervention session
		(c) and the distribution of episodes over the session
Dose form	The typical task/activity/context within which the teaching episodes are delivered	The typical setting within which the teaching episodes are delivered
Dose frequency	The number of times a dose of intervention is provided per day and per week	Average number of times a dose of intervention is provided per week
Total duration	The time period over which a specified intervention is presented	Number of weeks during which an intervention is implemented
Cumulative index of intensity	The product of dose × dose frequency × total intervention duration	The product of dose multiplied by frequency of dose and total intervention duration

With permissions from American Speech-Language-Hearing Association (ASHA): Language, speech, and hearing services in schools. Parker-McGowan et al. (2014, pp. 351–364), Table 1

Smith, Jahr, & Eldevik, 2002; Harris, Handleman, Gordon, Kristoff, & Fuentes, 1991; Howard, Sparkman, Cohen, Green, & Stanislaw, 2005; Lovaas, 1987; Romanczyk, Lockshin, & Matey, 2001; Smith, Groen, & Wynn, 2000). Some of this work is difficult to evaluate in that variables in addition to dosage have been simultaneously manipulated within the comparisons being made. We do know that full disclosure of the treatment dosage parameters outlined by Warren et al. (2007) is rare in empirically based communication intervention work (Parker-McGowan et al., 2014). This results in the question "how do interventionists determine dosage parameters?"

Brandel and Loeb (2011) surveyed almost 2,000 school-based speech language pathologists to determine what factors (i.e., student characteristics, workplace characteristics, or intervention characteristics) influenced their recommendations regarding intervention program intensity. They found that dosage parameters were not regularly monitored. They also found that caseload size, years since graduation, number of years working in a school, and severity of the learner's disability were important variables used to determine intervention intensity. It is possible that for any given intervention, there is no "magic bullet" for dosage. Instead, it may be that dosage is best considered as an evaluation strategy to determine what allocation of time and resources may best serve a learner in a particular curricular area. As such,

it is a decision-making tool. An additional area for future research is the impact of all dosage components on generalization and maintenance of skills.

Fey et al. (2013) explicitly asked the question "is more better?" (p. 679) with respect to milieu teaching intervention. This seems a reasonable question given that some interventions comparing dosage parameters have not controlled for reinforcement or task preference across comparisons of dosage. We hypothesize that more may not always be better, particularly when the learner has limited or modest incentive to persist longer in a task. More carefully controlled research examining the parameters of dosage represents a critical need in the ASD communication intervention literature.

In our discussion here, there may be some oversimplification of issues related to intervention dosage. For example, among more social pragmatic oriented AAC intervention strategies, relying on a learner's lead for some of the teaching episodes may make it difficult to implement a given number of teaching episodes in a session. In addition, the natural environment, such as a loud classroom, may make it more difficult for an interventionist to initiate a predetermined number of teaching episodes or sustain intervention for a set period of time. In spite of the challenges (given the scarcity of research related to dosage), there are a number of directions for future research, including (a) clarification about optimal treatment intensity within learners and across skills, (b) clarification about optimal treatment intensity across learners with similar characteristics, (c) impact of dosage on generalization and maintenance, and (d) the application of dosage parameters to more naturalistic social-communication interventions.

In considering features of a learner's communication system as well as the treatment dosage/intensity and the conditions under which newly taught behavior will be used, it is also important to consider that whatever planning is done is likely to involve parents and other stakeholders who may not be highly trained interventionists. Thus it is important to consider the range of potential interventionists who will be interacting with a learner and the contextual fit considerations that entails.

Implementing instruction in authentic environments is particularly important for learners with ASD in that it places reduced demands on the learners' need to generalize a behavior acquired in a "clinical" setting to home, school, and community environments. To maximize the utilization of authentic environments, a number of interventionists have implemented intervention procedures that utilize parents and siblings as potential interventionists.

9.12 Facilitation of Peer- and Parent-Mediated AAC Instruction

One strategy to enhance the generalization of AAC intervention is to involve family members not only in the planning process but also in the implementation process as well. Because communication is a ubiquitous skill, it is critical to provide supports

for all contexts that a learner will encounter. Investigators have examined AAC implementation with a variety of communication partners. Studies involving parents (see Chap. 11), peers, and school staff as implementers of AAC have indicated that their applications may be as effective as those implemented by highly-trained researchers (Durand, 1999; McMillian, 2008; Nunes & Hanline, 2007; Park, Alber-Morgan, & Cannella-Malone, 2011; Sigafoos et al., 2004; Trottier, Kamp, & Mirenda, 2011).

When involving a range of stakeholders in intervention, care must be taken to plan from the early stages of intervention to ensure that generalization to varied communication partners occurs, as it is unlikely to do so without targeted intervention. Unfortunately, research with natural communication partners, particularly family members, is sparse; if expanded it could prove to have important implications for intervention (Ganz et al., 2013; Hong, Ganz, Gilliland, & Ninci, 2014).

Collaboration with family members as well as the immediate community in which the learner resides involves carefully considering the influence that ethnic, racial and linguistic diversity may have on intervention support needed and provided. Although numbers of Americans with developmental disabilities from culturally and linguistically diverse backgrounds are growing, some populations, such as learners with ASD, are growing very dramatically (Centers for Disease Control and Prevention, 2012). While AAC research focusing on diversity with people experiencing CCN and ASD from such backgrounds is sparse (Boesch et al., 2013; Ganz, Simpson, & Lund, 2012; Seung, Siddiqi, & Elder, 2006; Valicenti-McDermott et al., 2013), some research is reported. For example, bilingual parents of persons with ASD, some of whom had CCN, have noted the benefits of providing bilingual communication opportunities to increase employment and community inclusion opportunities (Kay-Raining Bird, Lamond, & Holden, 2012). Further, because many forms of aided AAC applications have strong iconicity, they may be particularly well suited for this population. Further, picture-based systems may include written translations in two languages, promoting growth in both the home and community languages and providing concrete reinforcement of abstract language concepts (Ganz, Simpson, et al., 2012). Language skills of bilingual children with ASD are no worse than language skills in monolingual children with ASD (Petersen, Marinova-Todd, & Mirenda, 2012); thus, it seems prudent to honor both the language of the family and that of the community when providing AAC interventions for people with ASD.

9.13 Conclusion

In summary, this chapter introduced the concepts related to the selection and implementation of AAC systems. Initially, concepts and terminology related to intentional and non-intentional communicative acts were defined. Second, the two categories of AAC, aided and unaided, were defined as were the continua of systems and strategies within the categories. Advantages and disadvantages of

each of these categories were explored. Third, topics related to the selection of communicative mode(s), functions, and symbols to teach during the early stages of intervention were considered. For example, variables including an individual's communicative repertoire, as well as personal preferences and the targeted communicative function, were defined. In addition, FCT as it relates to potential collateral gains that have been reported in learners who were taught to use augmentative communication systems was elaborated. Fourth, available instructional formats were reviewed along with a call to consider overall intervention intensity and specific intervention parameters of dosage when selecting a format. Finally, we considered generalization and discussed strategies to enhance it.

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