Supporting Augmentative and Alternative Communication Use by Beginning Communicators With Severe Disabilities

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Augmentative and alternative modes of communication (AAC) have assumed an increasingly important role in meeting the communicative needs of individuals with severe disabilities. Despite the potential of AAC to enhance an individual's communicative effectiveness, practitioners may encounter challenges in implementing AAC interventions with individuals with severe disabilities. This article provides strategies addressing some of the challenges faced by practitioners as they teach beginning communicators with severe disabilities to use AAC. Specifically, this article discusses strategies for dealing with situations when learners (a) have AAC systems but are not using them, (b) have AAC systems but their communication partners are not actively participating, or (c) use alternative, but socially or contextually inappropriate, strategies for communication. This article culminates in a framework for increasing the effectiveness of AAC interventions and presents a discussion of needed research.

Key Words: augmentative and alternative communication (AAC), severe disabilities, response efficiency, matching theory

Augmentative and alternative communication (AAC) refers to the use of devices or techniques that supplement or replace an individual's spoken communication skills (Mustonen, Locke, Reichle, Solbrach, & Lindgren, 1991). AAC includes unaided modes of communication that rely completely on the users' body to convey messages such as gestures, sign languages/systems, and facial expressions. AAC also includes aided communication modes that require the use of tools in addition to the user's body. Augmentative and alternative communication can range from low-tech systems (e.g., line drawings on a communication board, written words on a pad of paper) to high-tech systems (e.g, laptop computers with synthesized speech output, dedicated AAC devices with digitized speech output).

AAC has enormous potential to enhance the lives of individuals. It can promote independence, promote the development of social relationships, and facilitate the acquisition of skills in classroom settings (e.g., Mirenda, Iacono, & Williams, 1990; Sullivan & Lewis, 1993). It has assumed an increasingly important role in meeting the needs of individuals with severe disabilities (e.g., Cafiero, 1998; Johnston, McDonnell, Nelson, & Magnavito, 2003; Johnston, Nelson, Evans, & Palazolo, 2003; Marcus, Garfinkle, & Wolery, 2001; Mirenda & Ericson, 2000; Quill, 1997; Reichle & McComas, 2002; Reichle et al., 2002; Rowland & Schweigart, 2000; Schopler, Mesibov, Shigley, & Hearsey, 1995). Despite its potential to enhance the communicative effectiveness of individuals with severe disabilities, practitioners regularly encounter challenges in implementing AAC interventions. This article provides strategies for addressing some of these challenges in teaching beginning communicators with severe disabilities to use AAC. Specifically, this article discusses strategies to address situations in which learners (a) have AAC systems but are not using them, (b) have AAC systems but their communication partners are not using them, or (c) use alternative, but socially or contextually inappropriate, strategies for communication.

1058-0360/04/1301-0020

Learners Do Not Use Their AAC Systems

Sometimes, beginning communicators with severe disabilities have an AAC system but use it infrequently. One possible reason for limited use may involve the efficiency of the AAC system compared with the efficiency of other competing behaviors. Herrnstein (1961) demonstrated that the distribution of behavior among concurrently available functionally equivalent alternatives depends on the history of reinforcement for each of the available behaviors. This led to the hypothesis that when individuals have two or more responses in a functionally equivalent class, they will select the response option that is perceived as most efficient in procuring or maintaining reinforcement (Mace & Roberts, 1993). For example, a child may have learned that either a tantrum or touching a graphic symbol (that produces the spoken message "could you come here") will gain attention. The option that results in the greatest reinforcement value for the least work is apt to be the more frequently used communicative act. Response efficiency is influenced by at least four variables: response effort (Bauman, Shull, & Brownstein, 1975; Beautrais & Davison, 1977; Horner & Day, 1991; Horner, Sprague, O'Brien, & Heathfield, 1990; Mace, Neef, Shade, & Mauro, 1996; Richman, Wacker, & Windborn, 2001; Skinner, Belfiore, Mace, Williams-Wilson, & Johns, 1997), rate of reinforcement (Conger & Killeen, 1974; Horner & Day, 1991; Mace, Neef, Shade, & Mauro, 1994; Martens & Houk, 1989; Martens, Lochner, & Kelly, 1992; Neef, Mace, & Shade, 1993), immediacy of reinforcement (Horner & Day, 1991; Logue, 1988; Neef et al., 1993; Rachlin, 1989), and quality of reinforcement (Hollard & Davison, 1971; Mace et al., 1996; Miller, 1976; Neef & Lutz, 2001; Neef et al., 1993). McDowell (1988) hypothesized that these components interact to influence the probability that an individual will engage in one response option over another.

It seems likely that the components of response efficiency may influence a learner's use of AAC. Consider a learner with cerebral palsy who chooses to refrain from producing spontaneous communicative behavior using a voice output communication aid (VOCA). This lack of spontaneity may be a result of the physical effort required to communicate (e.g., if the motor demands associated with accessing the communication device are too great, the learner may choose not to use it). Alternatively, the learner may refrain from producing spontaneous communicative behavior because the quality of reinforcement provided is not substantial enough to warrant the use of the AAC system (e.g., the learner may typically receive the desired outcomes regardless of whether or not they are spontaneously requested). Finally, the learner may not emit spontaneous communicative behavior because too much time lapses between the emission of the communicative behavior and the delivery of the reinforcement (e.g., communication partners do not hear or understand the AAC user's request and therefore do not respond in a timely enough fashion to make the use of the system worthwhile).

The following sections illustrate the potential role of the four components of response efficiency (response effort, rate of reinforcement, immediacy of reinforcement, and quality of reinforcement) in a learner's use of AAC. For each component of response efficiency, the outcomes of published empirical investigations are summarized in order to illustrate the potential influence of the components of response efficiency. In most cases, the authors of these investigations did not demonstrate directly the operation of the component being discussed because it was not the focus of their investigation. As a result, these summaries provide inferred, rather than direct, evidence of the operation of the components of response efficiency.

Response Effort

The effort required to produce a behavior can affect whether or not a learner will select that response (Bauman et al., 1975; Beautrais & Davison, 1977). The potential effect of response effort can be applied to a variety of situations. Typically, issues related to response effort revolve around the physical effort required to select a particular communicative act. Consider, for example, a team who considers whether to store words/phrases under single keys versus having a learner spell out messages when programming an electronic communication aid.

In addition to physical effort, cognitive effort may influence the probability that a learner will use a particular action. For example, when a learner can either point to a symbol representing "milk" on a 32-symbol array or proffer an empty glass in order to request, the cognitive effort required for the latter may be less than that of locating the "milk" symbol. Consequently, pointing to the symbol may be less likely if proffering an empty glass is equally apt to result in obtaining milk.

Horn and Jones (1996) provided an example of how cognitive effort may influence a learner's behavior. They examined the performance differences achieved by a 4-year-old child with cerebral palsy across two selection techniques, circular scanning and direct selection with a head-mounted optical pointer. Although pre-assessment data predicted that scanning would be a more appropriate technique, results revealed that direct selection was used more effectively as measured by response accuracy, acquisition rate, and response time to produce correct responses. The authors discussed that the child's less effective use of scanning was not due to a lack of understanding of the scanning process. Rather, errors were attributable to off-task behaviors and inattentiveness that resulted from the inherent slowness of the scanning selection technique.

Mizuko, Reichle, Ratcliff, and Esser (1994) illustrated how array size may influence the potential cognitive load for a learner using a graphic communication mode. They examined whether 22 typically developing 4-year-old children showed differences in short-term visual memory as a function of number of symbols available on the communication aid (10, 20, 30, or 40 symbols). Results revealed that when using row–column scanning, the participants performed better when there were 30 symbols

in the array as compared to when there were 40 symbols. These results might suggest that learner performance is influenced by the effort required to find and select symbols in larger arrays.

Reinforcement Rate

Herrnstein (1961) hypothesized that when individuals are presented with two or more functionally equivalent response options, their behavior will be directly dependent on the rate of reinforcement history associated with each alternative. The influence of reinforcement rate has particular significance for the implementation of AAC interventions. Consider a learner who is being taught to access a graphic mode communication system rather than grabbing for desired items. If all other variables were held constant, Herrnstein's hypothesis would suggest that reinforcement must be provided more often for using the graphic symbol than for grabbing.

Duker and VanLent (1991) demonstrated how the rate of reinforcement might influence a communicative production. This investigation was implemented to increase the variety of spontaneous signs emitted by 6 participants with severe to profound disabilities. Each participant used only a small portion of their signed vocabulary. To increase the variety of spontaneous signs produced, interventionists assessed the effectiveness of refraining from responding to the participant's high-rate signed vocabulary while at the same time delivering reinforcement for low-rate signed vocabulary (previously taught but typically unused). Results demonstrated that the teacher's nonresponding to high-rate spontaneous signs increased the participant's use of low-rate signs. Thus, manipulations of the rate of reinforcement provided in response to the participants' spontaneous communicative behaviors influenced their engagement in those behaviors.

Reinforcement Immediacy

The latency between producing a communicative act and the delivery of a reinforcer may also influence a learner's use of AAC. The influence of immediacy of reinforcement can be inferred from an investigation by Soto, Belfiore, Schlosser, and Haynes (1993). In this study, the investigators taught an individual with severe to profound mental retardation to use two different communication aids: a picture board (with no speech output) and a VOCA within functional routines. Following instruction on the use of both aids, the participant received opportunities to choose which aid to use in communicative exchanges. Results of this preference assessment revealed that the participant chose the VOCA in 100% of the opportunities. A plausible explanation of this outcome might be that the VOCA offered more immediate reinforcement (e.g., as a result of the voice output) than use of the picture board.

The influence of immediacy of reinforcement can also be inferred from a qualitative study examining the use of assistive devices in school settings. Todis (1996) quoted a teacher in a preschool setting for young children with and without disabilities who said:

> The AAC devices were often not right where we were, so by the time you walked over and pointed to it or went and got it, the moment was gone. It was very awkward. With kids that age you have to be right there at the time. They are not going to be right there and wait for you to go over and get the picture to communicate about it. (p. 56)

This teacher's statement suggests that, given the placement of the electronic communication aid, the students in her class were more likely to opt out of a communicative opportunity rather than tolerate the delay in reinforcement as a result of finding and using the AAC device.

In some instances the learner's selection of vocabulary specificity may be influenced by reinforcement immediacy. Understanding the relative benefits of general and explicit vocabulary can be helpful to interventionists as they design and implement AAC interventions. For example, consider an interventionist who is teaching a learner who has a general vocabulary (e.g, touching the symbol "want" to request desired items) to use more explicit vocabulary (e.g, candy bar, hot dog, soft drink). In this situation, the interventionist could manipulate the parameter of immediacy of reinforcement in the context of intervention opportunities. Specifically, when the AAC user communicates via general vocabulary, the interventionist can delay the provision of reinforcement by scanning the environment and then menuing options to determine what is desired. However, when the AAC user communicates via specific vocabulary, the interventionist can immediately provide access to the desired item.

Reinforcement Quality

Mace and Roberts (1993) discussed that when one event is preferred over another, the preferred event has a higher quality of reinforcement. Thus, reinforcement delivered contingent on a learner's use of a specific communicative behavior must be preferred over the reinforcement delivered for not using it. For example, consider a learner who is being taught to point to symbols on a graphic communication board to request desired objects. The more highly preferred the item, the more often one might expect it to be requested.

Brady, McLean, McLean, and Johnston (1995) observed the communicative initiation and repair used by 28 individuals with severe to profound mental retardation. These individuals produced intentional communicative acts, but did not use representational symbols. Tasks were created to provide opportunities for the participants to request instrumental actions (e.g., request objects) as well as to request attention to objects (e.g., comment). Results revealed that the participants initiated more requests for objects than comments. A plausible hypothesis is that tangibles may have been more reinforcing than attention. This preference may have influenced the tendency for participants to initiate some communicative functions more than others.

Examining the Interaction of Efficiency Variables in Designing AAC Interventions for Persons Who Use AAC Systems and Their Communicative Partners

Thus far, the four components of response efficiency have been discussed in isolation. However, McDowell (1988) proposed that these four components (rate of reinforcement, quality of reinforcement, response effort, and immediacy of reinforcement) interact to affect the probability that an individual will engage in one behavior over another. Thus, a person who uses AAC needs to analyze the interaction between a particular situation and the efficiency variables to determine the most efficient response to select when more than one communicative act is available. For example, in order to obtain attention in a noisy environment, an AAC user may be faced with the decision of using a natural gesture (such as approaching and tapping a communication partner's shoulder) or touching a key with the preprogrammed message ("Hey, I want to tell you something.") on a VOCA. The individual may choose to use the natural gesture even though it requires a greater response effort than using a VOCA. Choosing a more effortful communicative act may seem out of concordance with parameters of response efficiency. However, in a noisy environment, it may be impossible to make VOCA output loud enough for a listener to hear. Consequently, using the natural gesture may increase the likelihood that the communicative utterance results in the listener's response.

The interaction of the components of response efficiency also applies to the choice of what communicative mode to use in specific communicative contexts. For example, consider a learner who is able to reject nonpreferred items by using either a natural gesture (e.g., shaking head from side to side) or a voice output communication device (e.g., accessing a symbol in order to emit the phrase "no thanks"). Using a gesture, this learner is able to reject without searching for and accessing the appropriate symbol. Thus, the learner could perceive this as a saving of cognitive response effort. However, the tradeoff to this is that a listener will understand the gesture only if he or she is looking at the learner. If the listener does not see the learner's gesture, there may be a decrease in the immediacy of the reinforcement. Consequently, the most efficient communicators may have several different response forms that can be chosen depending on the efficiency demands of any given communicative context. For example, response efficiency may affect a learner's use of different communication modes as a function of their listener's primary communication mode. An individual may use the sign for hamburger in the home environment (where communication partners are familiar with sign language) but may point to a graphic symbol representing hamburger when ordering a meal at a fast food restaurant (where the likelihood that the clerk comprehends sign language is far less likely).

In summary, it is important to recognize the potential role of response efficiency in influencing the communicative behavior of AAC users. The first section of Table 1 summarizes issues to consider when addressing situations where learners do not use their AAC systems. In addition to considering issues related to the AAC user, it is important to remember that individual communicative acts that are topically related and flow back and forth between two or more partners characterize conversational exchanges. Thus, when one considers conversation, it becomes important to consider a communicative partner's perspective in defining response efficiency.

Communication Partners Do Not Participate Fully With a Person Using an AAC System

An effective augmentative communication system requires a commitment from all social partners, including family members, professional staff, and peers (Brinker, Seifer, & Sameroff, 1994; Brotherson & Cook, 1996; Gallimore, Weisner, Bernheimer, Guthrie, & Nihira, 1993; Musselwhite & St.Louis, 1988). In addition to providing a socially responsive environment, communication partners are in a position to ensure that a learner's AAC system is efficient (e.g, by providing immediate and high quality reinforcement). Thus, it is important to not only consider the needs and abilities of the individual with disabilities when designing an AAC system but also the preferences and interactional styles of the communication partners. This will increase the likelihood of a contextual fit. The term *contextual fit* refers to the congruence between an intervention and a variety of variables (e.g., characteristics of the person for whom the intervention was developed, characteristics of the individuals who will implement the plan, and features of the environment within which the intervention will be implemented; Albin, Lucyshyn, Horner, & Flannery, 1996).

Schepis and Reid (1995) conducted an investigation comparing the frequency of staff interactions with a learner who experienced multiple disabilities when the learner had access to a VOCA compared to when she did not have access to the VOCA and relied on vocalizations and gestures. Although the authors did not differentiate staff initiations and responses to learner-produced communication acts, results revealed that staff interacted with the learner more frequently when she had access to the VOCA. If these results are applied to response efficiency parameters, it could be inferred that the learner's use of the VOCA provided salient cues resulting in a higher quality and/or immediacy of reinforcement for the communication partners. Alternatively, the VOCA speech output may have been easier for communication partners to understand, thereby resulting in a savings of response effort. Although further investigation is necessary to determine which variable (or combination of variables) influences the communication of social partners, it seems reasonable to hypothesize that communication partners may be more likely to initiate and/or maintain communicative interactions with AAC if using AAC speeds up exchanges (immediacy of reinforcement), makes the exchange more explicit or understandable (quality of reinforcement), or lessens the need for the communication partner to act as an interpreter (response effort).

TABLE 1. Summary of some challenges and issues to consider for supporting augmentative and alternative communication (AAC) use by beginning communicators with severe disabilities.

Challenge	Issues to Consider
Learner doesn't use the AAC system	Response effort Physical effort or cognitive effort required to use the AAC system is minimized.
	Rate of reinforcement The learner is reinforced frequently for using the AAC system.
	Immediacy of reinforcement The reinforcement received after using the AAC system is not delayed.
	Quality of reinforcement The reinforcement provided for using the AAC system is motivating to the learner.
	Interaction of efficiency variables The combined influence of response effort, rate of reinforcement, immediacy of reinforcement, and quality of reinforcement is considered.
Communication partners are not using the AAC system	Response effort The physical or cognitive effort for interpreting the learner's communication via the AAC system is minimized.
	Rate of reinforcement The communication partner is frequently reinforced for using the AAC system.
	Quality of reinforcement The communication partner's use of the AAC system results in meaningful communicative interactions.
	Immediacy of reinforcement The communication partner's use of the AAC system results in immediate communicative interactions.
Learner uses socially or contextually unacceptable communicative behaviors	Socially unacceptable communicative acts A communicative act that is more efficient than the unacceptable behavior is identified.
	An intervention strategy that maximizes the efficiency of the new communicative act is implemented.
	An intervention strategy that minimizes the efficiency of the socially unacceptable behavior is implemented.
	Contextually unacceptable communicative acts The environmental contexts that should (and should not) elicit communicative acts are identified.
	An intervention strategy that maximizes the efficiency of each communicative act in the appropriate environmental context is implemented.

Sometimes, pragmatic rules in augmentative communication may influence aspects of response efficiency. For example, because graphic mode communication is very slow compared to speech, rate enhancement techniques may increase response efficiency from the perspective of a communicative partner. One way to enhance communication rate is for a listener to attempt to predict a word that is being encoded one letter at a time by an AAC system user. Mirenda and Bopp (2003) surveyed persons who used AAC applications. They found that some individuals were offended when their listener attempted to predict (viewing it as an interruption) an utterance prior to the AAC user's completed displayed utterance. On the other hand, other AAC users stated that they preferred listener prediction because it saved effort and speeded up the interaction. It is possible that rules regarding an AAC user's preference for partner guessing may depend on the familiarity of the partner and the partner's history of accurately guessing.

Another area related to response efficiency from the perspective of communication partners involves research examining the perceptions and attitudes of listeners (e.g, Beck, Bock, Thompson, & Kosuwan, 2002; Beck & Dennis, 1996; Beck, Fritz, Keller, & Dennis, 2000; Blockberger, Armstrong, O'Conner, & Freeman, 1993; Gorenflo & Gorenflo, 1991, 1997; Hustad, 2001; Lilienfeld & Alant, 2002). Generally, results suggest that the listener's gender (Beck et al., 2002; Beck & Dennis, 1996; Blockberger et al., 1993), the frequency and specificity of communicative cues (Hustad, 2001), voice output (Gorenflo & Gorenflo, 1991; Lilienfeld & Alant, 2002), the listener's age (Beck et al., 2000), the listener's experiences with individuals with disabilities (Beck & Dennis, 1996; Blockberger et al., 1993), information about the nonspeaking individual (Gorenflo & Gorenflo, 1991), and the perceived similarity in terms of values and activities of daily living between the listener and the augmented communicator (Gorenflo &

Gorenflo, 1997) may influence listener perceptions. Available information seems to indicate that variables related to response effort, quality of reinforcement, rate of reinforcement, and latency of reinforcement may influence a communication partner's perceptions regarding interactions with AAC users. Furthermore, the extent to which these variables influence perceptions may vary across communication partners. For example, communication partners who have had multiple experiences with AAC users may feel that communicative exchanges with AAC users involve less response effort than exchanges with communication partners with more limited experiences. Similarly, a communication partner who has perceived similarities in terms of values and activities of daily living with a specific AAC user may feel that communicative exchanges have a higher quality of reinforcement than exchanges with a communication partner who does not have perceived similarities with the AAC user.

In summary, it is important to recognize the potential role of response efficiency in influencing the behavior of communication partners. The second section of Table 1 summarizes the issues to consider when addressing situations where communication partners do not fully participate with a person using an AAC system.

Learner Uses Socially or Contextually Inappropriate Strategies for Communication

Sometimes, even though a learner has an alternative communicative strategy in his or her repertoire that is understood by communication partners, the form is either socially or contextually inappropriate. In these types of situations, the components of response efficiency may provide guidance in designing and implementing interventions that teach individuals with severe disabilities to engage in communicative behaviors that are more socially or contextually appropriate.

Socially Unacceptable Communicative Acts

Often, interventionists face the challenge of teaching beginning communicators with severe disabilities to produce new communicative forms to better express existing communicative functions. For example, when learners communicate a desire to play with a toy by hitting their peers, the interventionist's task may be to establish more socially acceptable communicative alternatives (e.g., selecting the symbol "my turn" in a communication wallet).

Horner et al. (1990) conducted an investigation in which the physical effort required for a 14 year-old learner with moderate mental retardation to request assistance using a VOCA as an alternative to engaging in challenging behavior was manipulated. In one situation, the learner was required to emit a high effort/low efficiency response (typing the phrase "Help Please" on a VOCA). In an alternative situation, the learner was required to emit a low effort/high efficiency response (pressing a single key on the VOCA to emit the phrase "Help Please"). This investigation revealed that the high effort response did not result in a sustained decrease in challenging behavior. However, the low effort response did result in a sustained decrease in challenging behavior. Results of this investigation attest to the role that relative response effort may play when a learner has several communicative acts that serve the same function in his repertoire.

Horner and Day (1991) conducted three experiments examining the role of response efficiency in teaching a communicative alternative to challenging behavior with 3 individuals who had severe to profound mental retardation (ranging in age from 12 to 27 years). In each experiment, participants were taught communicative alternatives that were functionally equivalent to their challenging behaviors but were not as efficient in terms of either physical effort (i.e., emitting the signs for "I want to go, please" as a replacement for escape-motivated aggression), schedule of reinforcement (i.e., emitting the sign "help" three times as a replacement for emitting self-injurious behavior to obtain assistance), or latency of reinforcement (i.e., receiving a break from tasks 20 s after handing the interventionist a card with the word "BREAK" on it as a replacement for escape-motivated aggressions). Results indicated that the new, functionally equivalent but inefficient, behaviors did not replace the challenging behaviors. However, when the alternative behaviors were made more efficient (e.g., signing "break" rather than the sentence "I want to go, please", signing "help" only one time rather than three times, receiving a break immediately after handing the interventionist a card with the word "BREAK" on it rather than 20 s later), there were dramatic reductions in challenging behavior and collateral increases in the use of the new communicative alternatives.

When a team is working together to meet the needs of an individual who engages in challenging behaviors, one important question to be addressed is "Does the existing behavior need to be replaced?" If the answer is "yes", the team must define a communicative act that will be more efficient than the current challenging behavior. Next, the team must develop a strategy to begin sufficiently reinforcing approximations of the new alternative in the presence of provoking stimuli. Finally, the team must ensure that reinforcement will be minimized for challenging behavior. For example, consider learner Rob, who throws a tantrum each time he is asked to eat vegetables. Currently, he pushes the vegetables to the floor and/or hits the individual offering the vegetables. Teacher Mark has observed Rob and believes that he can implement the following strategy.

1. Approach Rob with vegetables. As soon as Rob looks at them but does not engage in challenging behavior, the vegetables will be removed. (To ensure success, teacher Mark has stopped his approach out of Rob's arm reach.)
2. Across successful opportunities, the interventionist, in offering the vegetables, increases his proximity to Rob. If Rob refrains from challenging behavior, the items are removed.
3. Next, teacher Mark, in offering the vegetables, establishes very close proximity to Rob and touches Rob's arm (initiating contact to deliver a response prompt).

4. Across opportunities, touching Rob's arm becomes increasingly more intrusive until teacher Mark is physically prompting a "no" gesture.
5. Gradually and systematically, teacher Mark fades response prompts.

In summary, when an individual has two or more response forms that achieve the same communicative function, he or she is likely to choose the form that is the most efficient. Sometimes, the learners' prior interactions with others have resulted in communicative partners reinforcing a nonconventional or a socially unacceptable communicative form. Over time, these forms may become more efficient than other available socially accepted communicative forms that may be part of a learner's communicative repertoire. For example, in Rob's case, it is likely that pushing food and/or hitting the offerer resulted in meal termination or meal postponement in a large proportion of opportunities in which it was used. Gesturing "no" is much more socially appropriate, physically easier, and can result in immediate removal of the undesired item. In addition to encountering situations when a learner engages in socially inappropriate communicative behaviors, teams may also encounter situations where a learner has multiple, socially appropriate communicative behaviors in his or her repertoire but may be unable to determine which one is the most appropriate in a given context.

Contextually Unacceptable Communicative Acts

Unfortunately, establishing communicative behavior that is efficient from the learner's perspective may not be sufficient in establishing the social regulation skills that a learner needs to function responsibly in communicative contexts. For example, some events may result in a learner wanting to leave (escape) but not being able to do so immediately. An example may occur during more lengthy meals at restaurants when a child, upon finishing his or her meal, may ask to leave. If other members of his or her family aren't done, the child's request to leave can't be immediately reinforced. Learning when to refrain from producing a particular communicative act involves conditional use. Research has demonstrated that unless specific instruction is provided, some AAC users may have a difficult time successfully using their new communicative acts conditionally (Reichle & Johnston, 1999; Sigafoos, 1998). Using communicative acts conditionally requires that the learner be able to evaluate potential communicative opportunities to determine the relative efficiency of each available alternative.

Reichle and Johnston (1999) taught two beginning AAC users with severe disabilities to conditionally use communicative requests to obtain desired snack items in an elementary school setting. When items were proximally near, the learners were taught to directly reach for desired items. Alternatively, when items were in the possession of another person (a teacher or peer) or proximally distant, they were taught to point to a graphic symbol to request that the item be delivered. Results revealed that the students did not automatically engage in the most efficient strategy. However, efficient and conditional use was successfully acquired after fairly brief periods of intervention that maximized the immediacy of reinforcement.

In a related investigation by Reichle et al. (2002), an adult with severe intellectual disabilities was taught to request assistance when he encountered difficult work. In this study, the participant learned to point to a symbol representing "help" when assistance was needed but to independently complete a task when assistance was not necessary. First, prompts implemented to establish independent requests for assistance were faded. Immediately after a request for assistance occurred, the interventionist provided full physical guidance to enable the participant to perform the task. Once the participant was requesting assistance independently, prompts implemented to teach engagement in the activity were faded. The participant quickly acquired the skill of requesting assistance. Furthermore, as he became increasingly more skilled in independently completing the difficult task, he began to decrease his use of requesting assistance. The authors hypothesized that this switch in response strategy was related to immediacy of reinforcement. By analyzing videotaped sessions, they discovered that the length of time required to complete the task independently was less than the length of time required when emitting a request for assistance. As a result, independent completion resulted in a more immediate reinforcement (a break from work and access to snack items).

An investigation by Reichle and McComas (2002) also examined the conditional use of communication. In this study, a 12-year-old child who experienced a severe behavior disorder was taught to request assistance during the completion of math worksheets by raising his hand as an alternative to challenging behavior that functioned to escape difficult tasks. This new communicative behavior was acquired quickly. In this investigation, dependent measures included challenging behavior, requesting assistance, and independent/correct work. Challenging behavior was eliminated and requests for assistance occurred at a high rate. Unfortunately, there was no increase in independent solution of math problems. Subsequently, the participant was taught the target skill (adding a series of numbers during a math activity) that had been associated with the challenging behavior during the worksheet activity. Didactic sessions were implemented that did not involve the utilization of worksheets. During these sessions, interventionists implemented errorless instruction to teach the math skill without the learner being able to request assistance. Although the participant acquired this math skill, the investigators noted that the participant still had a propensity to engage in requesting assistance (hand raising) rather than to independently complete math problems during the worksheet activity. The authors speculated that this was because requesting assistance required less response effort than independent completion. To improve math worksheet performance, concurrent schedules of reinforcement were manipulated to establish conditional use of requesting assistance and independent problem solving. Specifically,

the participant received more immediate reinforcement contingent on independent problem solving than was available when he requested assistance. Results revealed that this change in reinforcement contingency resulted in the learner beginning to solve problems with increasing independence. The results of these investigations suggest that attention to variables related to response efficiency is an important factor to consider when designing and implementing AAC interventions that address the conditional use of communication.

In summary, it is important to recognize the potential role of response efficiency in designing and implementing interventions that teach individuals with severe disabilities to engage in communicative behaviors that are more socially or contextually appropriate than current behaviors. The third section of Table 1 summarizes the issues to consider when addressing situations where learners use alternative, but socially or contextually inappropriate, communicative behaviors. An example of how to use the variables of response efficiency when designing and implementing interventions for learners with severe disabilities is provided in the following section.

Designing Interventions With Response Efficiency in Mind

Variables related to response efficiency should be considered when developing interventions involving AAC for beginning communicators with severe disabilities. The interventions can be designed by examining the role of response efficiency for the AAC user and/or the significant others. For example, consider the investigation by Reichle et al. (2002), where the investigators manipulated the variables related to response efficiency to influence the behavior of an AAC user (discussed previously). Investigators were interested in teaching Eric, a 40-year-old man with autism and severe mental retardation, the conditional use of a graphic symbol to request assistance. At the beginning of the investigation, Eric did not have a symbolic means of requesting assistance. Furthermore, staff serving Eric reported that he did not attend to tasks long enough to allow him to execute activities such as assembly work. As discussed by Mace and Roberts (1993), the first step in incorporating the variables related to response efficiency into an intervention involves collecting information on the efficiency of Eric's current behavior. Table 2 summarizes information obtained by Reichle et al. (2002) about the four factors affecting efficiency that was collected via direct observation of Eric in his residential setting.

After obtaining information regarding the efficiency of Eric's existing behaviors, interventionists formulated an intervention procedure that competed with the current behavior across the four variables of response efficiency. In Eric's case, Reichle et al. taught him to touch a symbol representing "help" to request assistance. Table 2 illustrates how the interventionists adjusted the rate of reinforcement, quality of reinforcement, immediacy of reinforcement, and response effort for the treatment condition in the early stages of intervention. This table reveals that the adjustments made by the investigators resulted in the treatment condition receiving (a) an equal rate of reinforcement, (b) a higher quality of reinforcement, (c) an equal response effort, and (d) an equal immediacy reinforcement. These changes resulted in Eric associating a higher quality of reinforcement with requesting assistance rather than producing challenging behavior.

Future Research

Often, to identify variables related to response efficiency, interventionists have relied on incidental data (data that were collected to address other independent variables of interest). Experimental investigations are necessary to

TABLE 2. Summary of the rate of reinforcement, quality of reinforcement, response effort, and immediacy of reinforcement for the current behavior and for the intervention condition in the investigation by Reichle et al. (2002).

Factor Influencing Efficiency	Current Behavior (Walking Away From Work Tasks)	Initial Stages of Intervention[a] (Touch Graphic Symbol to Request Assistance)
Rate of R+	When Eric walks away from work tasks, he escapes task demands. Observation revealed that Eric successfully escaped from work tasks 90%–100% of the time.	Ensure that interventionists recognize and respond to Eric's requests for assistance 90%–100% of the time.
Quality of R+	When Eric walks away from a work task, he typically walks around the room or sits down in a chair. This is viewed by staff as a neutral activity.	Provide Eric with an opportunity to take a break from work and have a snack contingent on completing work tasks (regardless of whether or not assistance was provided). This is viewed by staff as a highly preferred activity.
Response Effort	The effort required for Eric to walk away from work tasks is low.	Place symbol in close proximity to Eric to decrease physical response effort. Use a most to least response prompt hierarchy to decrease effort involved in touching symbol and to decrease effort involved in completing the work task.
Immediacy of R+	When Eric walks away, he receives immediate escape from the work task.	Ensure that teachers respond to Eric's request for assistance immediately so the latency of reinforcement is equal to that of the current behavior.

[a] Once the new behavior is acquired, the interventionists may adjust the parameters of reinforcement to more natural proportions.

validate practical strategies that improve interventionists' capability to consider efficiency variables. Although not exhaustive, Table 1 provides some examples of the challenges and the issues to consider for supporting augmentative and alternative communication use by beginning communicators with severe disabilities. Attention to these challenges and issues has the potential to increase the overall efficiency and effectiveness of AAC interventions. The application of the components of response efficiency can be offered in a number of practical areas that pertain directly to AAC intervention. Some of these areas include the following:

1. **Establishing the conditional use of communicative acts.** Many communicative functions such as requesting assistance and requesting breaks appear to be relatively straightforward to teach. The challenge to interventionists is to establish strategies for the learner to determine when and when not to use them. Investigations are needed that demonstrate the successful implementation of strategies to establish the conditional use of communicative strategies. One promising strategy appears to be the use of competing schedules of reinforcement that make it more reinforcing to sustain a task (than to request a break) or independently complete work (than to request assistance).
2. **Establishing generalized use of new communicative behavior.** Traditionally, interventionists have assumed that when generalization did not occur the reason was likely that the learner didn't realize that the new behavior could be used in the generalized context. More recent investigations (Drasgow, Halle, & Ostrosky, 1998) have suggested that an alternative explanation is that the learner may be aware that a new response option is available but sees no advantage in using it rather than an existing behavior. In their study, Drasgow et al. demonstrated that, for some learners, making the old response form less efficient resulted in learners increasing their use of the new form. Empirical work is needed to determine the extent with which the efficiency of competing responses may explain generalization limitations among individuals with developmental disabilities.
3. **Enhancing communication exchanges.** It is likely that persons who are familiar with and value the augmentative communicator will tolerate less efficiency in communicative exchanges. Communicative opportunities with less familiar individuals may require a greater level of efficiency for the speaking partner in order to sustain exchanges. At the outset of an interaction, it may be important to determine the conversational variables that the listener most values (e.g., fast rate of transmission, completeness of message, flexibility in the AAC user's response). For example, at a fast food restaurant, the speed and accuracy with which a complete order can be communicated is critical. When placing an order with the fast food restaurant employee, it may be less important to be able to navigate a variety of conversational topics. Alternatively, consider a child who uses a communication board when interacting with a parent about the school day. For the parent, speed of interaction may be unimportant. However, accuracy of information and breadth of vocabulary to elaborate on the day's events may be more important. Intervention studies need to more carefully consider the relative importance of particular parameters of efficiency as a function of specific communicative context. Currently, there are virtually no data addressing the ability of persons using AAC systems to make judgments about the parameters of efficiency that must be addressed across the range of communicative contexts that occur during a typical day. However, it is clear that efficiency parameters are considered by many augmentative communication system users. Mirenda and Bopp (2003) described listener prediction as a rate enhancement technique. During listener prediction, as a user of an augmentative system begins letter encoding, the listener attempts to guess the message being encoded. One augmentative system user indicated that it was acceptable for a familiar person to guess, but not for an unfamiliar person to do so. One explanation for this preference is that familiar partners may be more likely to make accurate guesses based on their knowledge and familiarity with the speaker and the topics. Less familiar speakers might produce more errors, which would ultimately lead to more work for the AAC user to produce a clear message. Little empirical work has examined pragmatic rules used by augmentative communication users and their relationship to response efficiency.

In summary, this manuscript was designed to examine the influence that response efficiency may have on situations in which learners (a) have AAC systems but are not using them, (b) have AAC systems but their communication partners are not using them, or (c) use alternative, but socially or contextually inappropriate, strategies for communication. We believe that establishing communication systems that outstrip the efficiency of existing communicative systems for both users and partners of users of augmentative communication technology must be addressed if professionals are to improve AAC service delivery.

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Received May 13, 2003
Accepted November 10, 2003
DOI: 10.1044/1058-0360(2004/004)

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