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THE UNUSUAL SUSPECTS: MYTHS AND MISCONCEPTIONS ASSOCIATED WITH PECS

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The Picture Exchange Communication System (PECS) is an alternative/augmentative communication protocol designed to help children and adults with autism and related disabilities to engage in functional communication. The protocol was developed over a number of years and was based on Skinner's analysis of verbal behavior. Publications about the application and effectiveness of PECS have grown steadily. However, there also are many misconceptions about the protocol and its implementation. This paper reviews some of the research associated with PECS, describes several myths and misconceptions, and attempts to clarify many of the issues raised.
Key words: PECS, verbal behavior, communication training, AAC

The Picture Exchange Communication System (PECS) was developed over a number of years beginning in the late 1980s. Lori Frost, a speech–language pathologist, and I worked within a statewide public school program serving students with autism, and developed PECS while initially focusing on building essential skills in very young children (Bondy & Frost, 1993, 1994).

The PECS protocol and training sequence are based on the analysis offered by Skinner (1957) in his seminal work, *Verbal Behavior.* The training sequence begins by addressing simple requests, or mands, and then moves through a series of steps to involve generalization, picture discrimination, simple sentence construction, expanding vocabulary via attributes and other qualifiers, responding to requests by others, and commenting, or tacting. This review will look at some historical issues regarding the development of PECS and its associated research as well as some of the critical reviews regarding PECS, including potential misconceptions, both within and outside of the field of behavior analysis.

In *Verbal Behavior*, Skinner described a broad class of acts as *verbal*, defined as behavior mediated through the action of others. His analysis of language looks at particular functional units identified as *verbal operants.* These are distinguished by variations in antecedent and postcedent (i.e., consequence, as suggested by Vargas, 1984) aspects of the environment. While many behaviors are reinforced via direct changes in the environment, the reinforcement of verbal behavior is dependent on the mediation of someone else.[1] Skinner (1957) provided further elaborations on the definition of *verbal behavior* deeper in the book: "The 'listener' must be responding in ways which have been conditioned

1 Over time, people can learn to talk to themselves—enacting roles of both speaker and mediator—but this paper focuses on the early acquisition of the verbal operants.

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precisely in order to reinforce the behavior of the speaker" (p. 225, italics added). All of the factors that come to influence behavior—stimulus control, rates of reinforcement, conditional discrimination, and so forth—come to bear on verbal behavior as well.

Major classes of verbal operants include the mand, tact, intraverbal, echoic, textual, and the autoclitic. Each is differentiated by particular combinations of the elements of the three-term contingency (Table 1; see Frost & Bondy, 2006, for more details on these distinctions). These operant classes illustrate a *direct* relationship between the antecedent, the postcedent, and the particular verbal operant. Skinner also described a class of behaviors as being "impure." In such cases, several factors may influence an operant, resulting in multiple sources of control. For example, if someone says, "Honey, the moon is beautiful tonight," a reply of, "I'm glad you like it" would not truly reinforce the statement; thus, the statement is better described as an impure tact (emitted under the control of a combination of mand and tact controlling variables) than a pure tact. Research has also suggested that multiply controlled verbal operants can be highly specified by following the same approach (Bondy, Tincani, & Frost, 2004).

Table 1
Three-Term Contingencies for Major Verbal Operants

Antecedent	Postcedent/ consequence	Verbal operant	Example
Motivational operation	Direct	Mand	Mary walks into the kitchen, where Mom is sitting, and says, "**I want some milk!**" Mom opens the refrigerator and gives Mary some milk.
Aspect of the environment	Educational/ social	Tact	Johnny, looking out the window, turns to his teacher and says, "**It's hot today.**" His teacher says, "It sure is!"
Verbal behavior	Educational/ social	Intraverbal	Mom asks Tom, "How'd you do on your project?" Tom "**I got a B.**" Mom says, "Great!"
Verbal behavior	Educational/ social	Echoic (form is related to form of stimulus)	Mrs. Thompson says to Mary, "The capital of New Jersey is Trenton." Mary says, "**The capital of New Jersey is Trenton.**" Mrs. Thompson says, "Yes!"
Verbal behavior of self	Direct (in example, faster access to bathroom)	Autoclitic	Michael wakes his dad up during the night and says, "I'm **really** going to be sick." His dad rushes him to the bathroom.

Note. The words in bold text are examples of each particular verbal operant.

The main distinction between typical behavior and verbal behavior rests on an analysis of the three-term contingency and the source of reinforcement. Distinctions between different verbal operants may be related to distinct alterations of the form or topography of the response. However, Skinner's view on the role of modality when defining functional communication is clear: "In defining *verbal behavior* as behavior reinforced through the mediation of other persons, we do not, and cannot, specify any one form, mode, or medium. *Any* movement capable of affecting another organism may be verbal" (Skinner, 1957, p. 14, italics added). I will return to the importance of this perspective later as I review some potential critical comments about PECS.

The Key Elements of the PECS Protocol

PECS was developed with an awareness of these functions, and the construction of the phases was informed by the operants identified by Skinner. The protocol for PECS involves six key phases with some subset goals within certain phases (see Frost & Bondy, 2002, for more details on the specific protocol, as it is only briefly described herein). The first phase of PECS involves teaching the mand (or, more precisely, the mand/tact following the guideline provided by Bondy et al., 2004). The use of two trainers helps to minimize the

likelihood of prompt dependency.[2] In Phases I and II, only single pictures are presented, thus avoiding issues related to discrimination or "the meaning" of the pictures. That is, in these first aspects of training, the goal is to teach what to do with a picture (i.e., to give it to someone who controls access to a reinforcer); this part of training is not about the potential relationship between the picture and the item being offered. Changes in iconicity-related picture qualities do not impact the rate of acquisition in the first phase of training (see Angermeier, Schlosser, Luiselli, Harrington, & Carter, 2008). In the second phase, changes related to various aspects of generalization are introduced, including increasing the distance between the user and the communicative partner as well as increasing the distance between the user and the binder where pictures are kept. From this point onward, it is important that each user control his or her own binder and that trainers, parents, and others view the pictures as belonging to the user, not the teacher. Just as a speaker is fully in control of his or her voice apparatus and a signer should always control access to his or her fingers, so too should users of PECS or other communication devices have continuous and unimpeded access to their communication system. In this phase, issues related to persistence also are introduced.

The third phase of PECS addresses discrimination issues. Typically, the initial arrangement involves a picture of a highly preferred (or contextually relevant) item versus one that is nonpreferred (or contextually irrelevant). Specific error-correction strategies are recommended to ensure high rates of accurate discrimination. Further refinement of discrimination continues by moving to situations involving items of equivalent reinforcer valence, in which a correspondence check is arranged to ensure that a user takes an item that corresponds to the one requested. Essentially, initial discrimination training tries to exaggerate differences in the saliency of the reinforcer, while subsequent lessons aim to ensure that conditional discrimination is developed.

The next phase of PECS involves teaching simple sentence structure, such as "I want…cookie."[3] It should be noted that "I want" is a single icon, as at this point there is no one else to whom the child would refer; thus, at the moment, an isolated "I" would have no discriminative context. Once this simple sentence structure is formed, it becomes easier to introduce various attributes associated with specific reinforcers. Consequently, given that a child likes cookies, it is highly likely that a big cookie would be preferred over a small one. In such cases, it is fairly straightforward to teach "I want BIG cookie" prior to needing the user to respond in a listener (receptive) manner, as in "show me BIG." Of course, lessons must be arranged to vary within discrete pairs (e.g., big/little, in/out), such that each feature may be more highly associated with reinforcement in particular situations. Furthermore, the use of such attributes within a mand does not ensure that the child will appropriately respond to the same attribute as a listener (or receptively) without more explicit training.

The fifth phase of PECS ensures that the user not only can be spontaneous regarding manding but also can respond to simple questions, such as "What do you want?" In this phase, a teaching strategy that will be used in the final phase is introduced. The sixth and last formal phase of PECS involves teaching commenting (tacting). At first, the user is taught to respond to simple questions (e.g., "What do you see?" "What do you hear?") before attempting to teach more spontaneous, or pure, tacting. Furthermore, any attribute introduced in manding is taught in the tact function.

Those completing the full set of phases now can spontaneously and responsively request, spontaneously and responsively comment, and involve a variety of attributes for both major functions. Furthermore, such skills should be used with reasonable frequency with a variety of communicative partners and about a variety of reinforcers and events, and should occur in a variety of settings.

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2 The importance of the use of two trainers was noted in a recent Association for Behavior Analysis International conference presentation by Lavalley and Ross (2010).

3 The form of the carrier word/phrase denoting a mand function varies across languages and cultures. In this paper, I use only the structure and grammar of English.

When Was PECS First Noted in the Field?

The initial descriptions of PECS and its protocol were offered at various conventions, primarily the annual meeting of Association for Behavior Analysis International (ABAI). Beginning in 1987, Bondy, Frost (then L. Ryan), and others presented scores of papers regarding PECS use and effective strategies for implementation. The reliance on the analysis offered by Skinner was clarified in a paper entitled, "Autism and Initial Communication Training: How Long Have We Been Wrong?" (Bondy, 1988). Admittedly, this title was bold, but it attempted to draw attention to the view that the communication issues in autism did not reflect a speech disorder but rather a communication disorder; that is, these children demonstrated substantial difficulties in acquiring any manner of verbal behavior. A child could be speaking and yet not engaging in verbal behavior if his or her speaking was not under the functional control of the presence of a listener or if the reinforcers for speaking were not mediated by others.

PECS evolved over a number of years while attempting to teach verbal operants to many very young children with autism; that is, the protocol was not developed in toto with a single child. Furthermore, the protocol was developed within a purely applied and non–research-based environment, that is, a public school setting. At the time, there was little discussion about how evidence-based practice should be applied. Rather, elements were added to the protocol as a function of how well they successfully advanced some communication skill of specific students. The first publications were descriptive in nature, though some included outcome measures in terms of picture use as well as some indicators of the co-development of speech (Bondy & Frost, 1993, 1994). Independent publications regarding PECS use began in 1998 (I. S. Schwartz, Garfinkle, & Bauer, 1998), with several minor descriptions during the next few years. A significant, well-controlled single-subject design study was published by Charlop-Christy, Carpenter, Le, LeBlanc, and Kellet (2002), and this article remains one of the most frequently downloaded from the journal in which it was published (Society for the Experimental Analysis of Behavior, 2011). The rate of PECS-related publications held steadily for several more years and has risen sharply during the past few years, with nearly 40 related publications within the past 3 years, almost all of which were in peer-reviewed journals. Correlated with this increase in publication rate is an increase in literature reviews, with at least six published since 2009 (see http://pecsusa.com/research.php for up-to-date summaries of research publications related to PECS).

Can PECS and ABA Be Used Together?

Following the very first presentations and publications, an oft-repeated statement regarding PECS within the field of applied behavior analysis (ABA) suggested that "You can't do PECS and ABA." This statement implies that there is something fundamentally incompatible with doing a traditional ABA program and using PECS. From a Skinnerian perspective, this appears immediately surprising, as context is always an aspect of how particular operants are defined, not the "style" of the particular lesson.

As noted, the first talks and presentations regarding PECS occurred at the annual ABAI conferences between 1987 and 1993, with more than 20 PECS talks and posters. Additionally, there were another 20 on elements of the Pyramid Approach (a model that blends the principals of behavior analysis with a strong emphasis on functional communication as well as functional activities; see Bondy, 2011). Thus, the earliest descriptions of PECS were for audiences familiar with behavior analysis. Discussions about how to teach the effective use of PECS placed clear emphasis on the use of reinforcement, prompting, shaping, error correction, data collection and analysis, and a host of other primary features of a behavioral orientation. That PECS currently is viewed as mainstream within the broader field of ABA is evidenced by the fact that at the 2010 ABAI convention, 18 papers/posters involving PECS were presented by investigators having no direct association with the PECS originators.

Fundamentally, ABA is often misunderstood. It is therefore not surprising that PECS is often misunderstood as well. From my perspective, many people view ABA programs as solely relying on a discrete-trial approach, in which the teacher and a student sit at a desk and the teacher leads all lessons. Another common misinterpretation is thinking that discrete-trial lesson formats require a discriminative stimulus set that is occasioned initially by the teacher and thus failing to believe that lessons that focus on student initiation conform to "true ABA format" (see R. Leaf & McEachin, 1999, for a thorough review of myths regarding ABA programming). Because of the early popularity of Lovaas's (1987) work and Maurice's (1993) publication of *Let Me Hear Your Voice*, many came to view Lovaas's strategies as synonymous with ABA, causing anything that was not of this particular ilk to be seen by some as "non-ABA." Of course, many ABA strategies have been developed to promote initiation and generalization from early in a lesson, primarily strategies broadly based on "incidental teaching." The PECS protocol uses two trainers in Phase I to encourage rapid acquisition of manding without the communicative partner (i.e., the "listener") making any statements. Thus, the teacher using a particular reinforcer to entice the student to initiate would not say, "What do you want?" or "Give me the picture" or anything that might function as a prompt (or indeed, turn the intended mand/tact lesson into an intraverbal/mand/tact or some other even more multiply controlled mand). Withholding a direct vocal verbal antecedent presents a contrast between the PECS protocol and those often viewed as "traditional" discrete-trial protocols. In order to promote relatively spontaneous manding, a teacher cannot preset the number of requests a student must make in a session because the teacher cannot perfectly control the factor of motivation and satiation.

As long as one maintains that ABA does not have a single form or style, it would appear that PECS is an accepted part of the field. On the other hand, were one to insist that ABA should be restricted to the work developed by Lovaas, it should be noted that he included a chapter on PECS in his last significant book, *Teaching Individuals With Developmental Delays* (2003). Even with this inclusion, not everyone considers PECS to fall within a formal ABA approach. In a recent study purporting to compare a strict ABA package with one that is "eclectic" in nature, PECS was noted as falling within a group of eclectic strategies, rather than within a group of accepted components of an ABA program (Howard, Sparkman, Cohen, Green, & Stanislaw, 2005). This selection bias may relate to a failure to see that the Pyramid Approach reflects the broad scope of behavior analysis and that PECS is simply a part (a visually mediated system) of a part (functional communication) of the whole. Any broad application of behaviorally based strategies that provide educational programming may well include PECS for some individuals.

When Should PECS Be Introduced?

In many circles, the standard answer appears to be, "When all else fails!"[4] It should be obvious that humans' preferred modality for communication is speech, if for no other reason than it provides the widest set of communicative partners. Unfortunately, many children do not acquire speech naturally, and this includes most children with autism. A review of the history of communication intervention for these children shows a clear trend. The first approach focused on initiating speech as quickly as possible. There are several important factors that may influence the speed at which this approach will succeed. There are no direct means by which we can ensure the production of specific sounds from a child; that is, there are no physical prompts that guarantee the production of an *f* sound as opposed to a *v* sound. Instead, for a child to acquire an array of sounds that can be blended into words, phrases, and beyond, vocal imitation (an echoic repertoire) must be

4 In a personal communication, one popular speaker emphatically endorsed the use of sign language, saying that as long as there was a single echoic—a single sound under imitative control—he would avoid the use of PECS. In effect, this denies that the reinforcement of one form of mand would reinforce all mands independent of form or modality.

demonstrated. However, poor imitation skills are a reliable diagnostic indicator of autism for very young children (Stone, McMahon, & Henderson, 2008). Therefore, many programs begin with an emphasis on imitation of body actions and vocal imitation. Here, too, the fact that many young children with autism do not make consistent eye contact may cause a problem; this absence might then require training in eye contact, joint attention or reference, or similar prerequisite skills. How often this speech-only approach is successful for young children with autism within a fixed period of time is hard to determine, but there are consistent reports that a substantial number of such children do not rapidly acquire a large set of functionally useful spoken words.[5]

The second major historical approach to communication strategy concerns sign language. In the literature, there are many examples of individuals turning to sign language as an alternative communication system to speech. Some[6] have argued that this may be helpful because many children with autism appear to be visually oriented; however, whether such a modality preference is a true reflection of the condition is remarkably difficult to empirically demonstrate (see Lovaas, 2003, for many comments about "visual learners"). Many of the early attempts at teaching sign language to children with autism were not based on Skinner's analysis of the verbal operants. The effects of this approach for children with autism have been highly controversial and underresearched. In a review of research regarding sign language with this population, Layton and Watson (1995) concluded, "Even after intensive training with signs, a significant number of nonverbal children continue to be mute and acquire only a few useful signs" (p. 81). While the work of Layton was not guided by Skinner's analysis of verbal behavior, Layton's work is often cited as supporting the use of sign language for children with autism (see Carbone et al., 2006, for one example), although his own review statement is absent. More recently, there has been renewed interest in the use of sign language from a verbal behavior analytic perspective (to which I will return shortly). However, this renewal of interest in sign language continues to need further empirical support, as indicated by a recent review of the broad literature on the effectiveness of sign language with individuals with autism, which concluded, "In this review, the evidence on the use of sign language with children with autism provides limited support for its concentrated application for children with autism, as there is little compelling evidence that sign language provides substantial improvements in either oral or sign language communication" (J. Schwartz & Nye, 2006, p. 14).

A third historical thrust involves the use of pictures to aide communication. The first strategies involved having a user point to a picture (item or icon) from an array. Often, a matching-to-sample strategy was used and a distinct hierarchy of matching tasks was recommended, starting with object-to-object and then moving to object-to-picture, picture-to-picture, and finally picture-to-object. The primary limitation of this approach is that the acquisition of matching-to-sample skills does not ensure that verbal behavior has been acquired. That is, learning about the relationship between a picture and an object does not necessarily teach the learner to direct a communicative act toward the listener. More recently, the advance of computer technology has fostered the development of a number of speech-generating devices, or SGDs. Many find these appealing because they "give the child a voice." Although this outcome is obviously enticing, pushing a button that produces an electronic (or taped) voice does not ensure that the action is under the stimulus control of an audience, and thus this may not function as verbal behavior. In terms of research, an exhaustive review of the literature on such devices and PECS for individuals with autism did not reveal that these devices are more likely than PECS to promote the acquisition or expansion of speech (Lancioni et al., 2007). The reviewers stated, "The fact that speech improved in studies using PECS programs rather than in studies using VOCAs [i.e., SGDs]

5 Scores of informational Web sites about autism note that "about 40% of children with autism do not speak" (National Autism Association, n.d.), though they rarely cite the empirical evidence for this figure.

6 AutismParenthood.com (formerly known as www.americanautismsociety.org) noted, "Since many autistic kids are visual learners, signing often comes more naturally to them than spoken language" ("Parents of Autistic Children," n.d., para. 9).

may constitute a certain surprise" (Lancioni et al., 2007, p. 482). Whether such surprise is simply a reflection of the initial bias regarding levels of technology is not known. One difference between various picture-point systems and PECS is that the exchange guarantees that the user is behaving in an interactive manner with someone else—someone who then provides reinforcement for that action.

In general, there have been few clear criteria suggesting when to introduce pictures or sign language to children demonstrating difficulty in acquiring speech. It appears universally accepted that the initial focus of intervention should be on rapid speech acquisition. What we need are clear guidelines regarding how many or what types of attempts to make (or what other behavioral criteria will be used) before trying an alternative. One of the first guides to behavioral strategies in autism was the seminal work by Lovaas (1981; known as "The ME Book"). In the section on vocal imitation, it is noted, "If you work for 2 or 3 months on verbal imitation training and your child is not making much progress (cannot imitate five or more succinct sounds), then you should consider minimizing or dropping the program" (p. 90). At that time, the alternative recommendation was sign language. In the more recent revision by Lovaas (2003), the alternatives are a Read/Write Program or PECS. It appears that the guideline of allowing no more than 3 months of no progress on speech before introducing an alternative modality has often been ignored by practitioners. Furthermore, it is not clear if any data-based criteria are relied on in the field as a whole; that is, given the wide variations across children with autism with regard to acquiring speech, it is difficult to opt for a hard-and-fast rule about when to introduce alternative/augmentative systems. The question remains, Is there any evidence-based reason to delay the introduction of such systems?

The decision of when to introduce PECS is fairly simple and direct. If someone enters a program without any verbal operants, PECS should be introduced immediately. Of course, beginning PECS immediately does not interfere or compete with working on vocal production, vocal imitation and blending, and other skills that are necessary to produce functional vocal verbal behavior, and these would certainly be targeted with young children. However, there is no reason to wait for failure in the vocal mode in order to work on verbal behavior. I will return later to the issue of the relationship between PECS and speech. The primary point here is that viewing autism as a communication (or verbal behavior) disorder, rather than a speech disorder, leads to the immediate emphasis on acquiring any mode of functional communication as rapidly as possible. Furthermore, there are virtually no prerequisite skills needed prior to the introduction of PECS. Once a user's key reinforcers have been identified, the elements of Phase I can be introduced. This is not to say that skills such as making eye contact, sitting in a chair, and reducing stereotypic behaviors are not beneficial; rather, the view is that these are not prerequisites to beginning training of the mand function via PECS.

When Should We Stop Using PECS?

For many people, the answer seems to be "the moment we hear the first word (or sound) from the user!" That is, PECS is often viewed as helpful only for those who have absolutely no words (or sounds, argue some). Many have advised that the moment vocal acts are heard, the PECS communication system should immediately be taken away from the user. This view—the fear that PECS will diminish or interfere with speech—has been espoused by those within and outside of the field of behavior analysis and will be reviewed from several perspectives.

Within the broad field of speech–language pathology exists a subspecialty, augmentative/alternative communication, or AAC. This field, which has generated interest and research for more than 40 years, is rooted in helping adults who have lost speech production, often as a result of severe head injury or other types of insults. The term *alternative* suggests that one strategy or modality, such as sign language, is used instead of—as an alternative to—speech. The term *augmentative* suggests that one system or modality, such

as an electronic communication device, augments, or improves, the use of some other modality, most often speech. In an augmentative case, the use of sign language would be demonstrated to improve the speech of the user. Although the commonly used acronym AAC means both alternative and augmentative, it appears that many people focus their attention on the "alternative" aspect. When this partiality is the case, it seems reasonable to fear that the use of one modality or system would interfere with the use (or growth) of another. Thus, a child who has no speech should use PECS, but the moment the child demonstrates some vocal output, there should be an immediate cessation of the use of the alternative strategy. The issue of AAC abandonment is not unique to PECS, and many factors influencing this choice are reviewed by J. Johnson, Inglebret, Jones, and Ray (2006). Should this predisposition against augmentative effects be supported from a behavior analytic perspective?

One of the most important terms that Skinner (1937) coined was *operant*. These are behaviors defined by their effect on the environment—how they "operate" on the environment. Thus, operants are defined by their functional relation to preceding and consequential events and not merely by the form or topography.[7] Several "different looking" behaviors may be said to be in the same operant class if they co-vary in systematic ways with variations in the environment. Tapping the table with my fingers, hitting the table with my elbow, or knocking my head against the table may all be viewed as members of a "noise-making" class of behaviors. That they are topographically distinct does not rule out their joint membership in a particular operant class. The entire growth, and noted importance, of doing a functional assessment, or functional analysis, of contextually inappropriate behaviors rests on this idea that many seemingly distinct behaviors may in fact be members of the same behavioral class. Thus, rather than seeking to eliminate a particular isolated behavior, it may prove more effective to reinforce functionally equivalent alternative behaviors—members of the same operant class but those that may be viewed as more "appropriate" by societal standards or even merely more efficient over time and across situations.

It would seem, then, that a complete understanding of behavior analysis would lead to a ready recognition that one form or modality of a behavior may simply be another member of a broader class of operants—communication, verbal behavior, manding, and so forth—wherein reinforcement for one member affects all members.[8] To insist that the novel production of a new member of a class (a spoken mand, perhaps) should result in the denial of access to the production of another form of this class (e.g., a mand created via use of pictures) is not consistent with the core analysis of the contingencies responsible for operant behaviors. This emphasis on function over form appears to be what Skinner was pointing out in his comment cited earlier about "form, mode, or medium" (Skinner, 1957, p. 14). The field of behavior analysis should embrace the premise of the field of AAC.

How then does PECS fit in to AAC? For some users, PECS is clearly an alternative system; that is, they use PECS and display no vocal verbal behavior. However, for other users, PECS clearly functions as an augmentative system; that is, while using PECS, they speak more words, either in terms of overall vocabulary or in terms of the complexity of particular sentences. There have been many demonstrations showing that children using PECS can say many words in a complex sentence (e.g., "I want big blue balloon") but only a single word (e.g., "balloon") when denied access to their pictures (Frost, Daly, & Bondy, 1997).

Another possibility is to consider not removing PECS and assessing whether its use is having either an alternative or an augmentative effect. Here are five critical questions that Frost and McGowan (2011) recommended be answered before making the decision that a child no longer needs to use PECS (and I would argue this list holds true to the transition between any two modalities). Each of these may lead to data-based decisions on an individual basis.

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7 That is not to say that a change in form within a class of behaviors would not be associated with distinct functions. It only implies that by form alone, absent other information, function is not necessarily revealed.

8 That is not to say that one cannot use differential reinforcement to shift the probabilities of a particular member of an operant class. The point is that such differentiation is not a function of class membership itself.

1. Does the number of spoken words match the number of pictures used?
2. Is the rate of initiation with speech the same as when using PECS?
3. Is the mean length of utterance (MLU) or the complexity of sentence structure with words equal to that produced via PECS?
4. Is the spoken production understood 80% of the time by novel/untrained listeners?
5. Is the rate (fluency) of response production at least as fast as when using PECS?

If the answer to any of these questions is "no," then removing access to pictures—taking the PECS picture binder away—would result in the removal of skills. Taking away skills from a child (or adult) is simply unethical from a variety of professional standards. During a transition from one set of skills to another, nothing should be lost.

Myths and Misconceptions Associated With PECS

There are many current misconceptions and views regarding the use and implementation of PECS that should be considered myths. I review a number of these in an attempt to understand their basis and how realistic concern about them might be.

There Is Little Research to Support PECS

As noted earlier, there has been a steady growth of PECS-related research over the years, a trend that has markedly increased of late. There have been more than 100 publications, including book chapters and literature reviews, concerning PECS, and more than 60 of these involve case studies or other data-based work. These publications have developed an increasingly international flavor, as they reflect the involvement of authors from 15 countries (see Sulzer-Azaroff, Hoffman, Horton, Bondy, & Frost, 2009, for examples). There are now at least six reviews of the literature, each leading to somewhat different emphases, depending in part on which publications have been included. Some publications have claimed to represent PECS but have either clearly not followed the protocol or provided no evidence that the protocol was followed in a consistent manner.[9]

Another major problem in interpreting these publications is the fact that some have only examined a portion of the protocol (see Sulzer-Azaroff et al., 2009, for a complete review of this issue). For example, some studies have looked at effects only through discrimination (i.e., Phase III), not because there were documented problems in getting users to achieve Phase IV and beyond or because their use of the early phases of PECS led to the rapid acquisition of alternative forms of functional communication (including speech), but for other, nonspecified reasons (including, perhaps, pressure to publish). These incomplete attempts to teach the full protocol when comparing PECS to some other system or modality make the comparisons difficult to interpret (see Sulzer-Azaroff et al., 2009, for a full review of these and other quality-assurance issues). When only a portion of the PECS protocol is used, it is difficult to understand the full meaning of questions comparing PECS to other programs. This issue is especially relevant when production of speech is of concern because several studies suggest that changes during Phase IV and its corresponding delayed-prompt strategy for speech production are associated with a significant boost in vocalizations across the PECS phases (see Ganz & Simpson, 2004; Tincani, Crozier, & Alazetta, 2006). Of interest is some preliminary evidence offered at a recent ABAI paper presentation that suggests that shifting the use of the delayed-prompt strategy from Phase IV to Phase II may result in a concomitant shift in increased vocalizations (Rapoza-Houle & Muehlberger, 2010). When attempting to compare two different systems, it may be impossible to separate issues uniquely associated with the modality from the teaching strategies associated with the use of that modality. That is, using a teaching protocol

9 In some situations, although PECS is discussed in the body of the article, the method described is clearly that of a picture schedule rather than PECS per se (see Dooley, Wilczenski, & Torem, 2001, for an example).

distinct from that described by PECS to teach the use of pictures within a manding function could result in vastly different outcomes than if the current PECS protocol had been used. Poor teaching strategies could be associated with the failure of any modality.

Most of the current review papers call for more detailed research regarding how PECS relates to overall functional communication, speech development, behavior management, and social skill modifications. In a review of published single-subject design studies, Hart and Banda (2010) noted, "In summary, PECS may increase manding, social communicative behavior, and speech and decrease problem behaviors" (p. 486). Another review, by Tien (2008), concluded,

> Taken as a whole, therefore, results of the studies reviewed provide evidence for the effectiveness of PECS; specifically, PECS is effective in enhancing functional communication skills of individuals with ASD. Therefore, PECS is recommended as an evidence-based intervention for this purpose. (p. 74)

Tincani and Devis (2011) wrote, "The findings of this meta-analysis support the PECS as an effective intervention to promote functional communication for individuals with ASD and other disabilities" (p. 9). Other reviews have been more conservative in their overall assessment:

> With one group design of strong quality and seven single subject experiments of at least adequate quality documenting gains in communication following PECS training, the body of evidence for the PECS approach demonstrates that PECS is a promising, although not yet established, evidence-based practice for promoting communication in children with autism. (Flippin, Reszka, & Watson, 2010, p. 189)

Finally, Tincani and Devis also stressed the importance of research regarding the efficacy of the more advanced phases of the PECS protocol.

Although seemingly simple, the question of whether PECS works has many facets.[10] For example, this question may focus on the acquisition of the use of pictures within the protocol described. On the other hand, Does PECS work? could be interpreted to mean, Did the user acquire speech? or How did the use of PECS impact a broad array of other behaviors, from social orientation to behavior management? In terms of acquiring the use of pictures alone, Lancioni et al. (2007) noted only three failures of 173 reported PECS users. With regard to the impact on speech, one factor may be developmentally sensitive, involving the range of ages during which PECS and speech production are assessed. For example, in a well-controlled, random-group-assignment study by Howlin, Gordon, Pasco, Wade, and Charman (2007), the mean age of the target group was 6.8 years, and two standardized assessments were used to evaluate broad outcome changes. This type of assessment is severely limited because I do not know of any interventions that have demonstrated substantial changes in speech for children of this age (especially for children who display no vocal production). The fact that 6 months of teacher training on how to implement PECS did not change such measures should not be surprising nor suggest significant limitations of this modality. Furthermore, of the two standardized tests, the one involving expressive communication targeted tacting (naming) a series of pictures, whereas the other test involved having children respond to spoken words by pointing to various pictures. The students who achieved completion of Phase VI could have produced a small tacting repertoire relating to the stimuli used, but it would be remarkable for any intervention to result in substantial generalization to receptive skills within 6 months of introduction. Of direct concern is the assessment of skills that did change as a function of PECS training with this population over this period of time. Skills taught directly by the PECS protocol (i.e.,

10 The ensuing issues are similar to those raised by attempts to define *evidence-based practice*. For a more complete discussion and description of how such standards are set, see National Professional Development Center on Autism Spectrum Disorders (n.d.).

initiation and use of pictures) did in fact improve (although the study did not measure the number of pictures used per student).

If We Are Using Pictures of Any Kind, We Are Using PECS

Perhaps in part because of the popularity of PECS, some people say they are using PECS when that is not the case ("Do you use PECS?" "Sure! See those pictures on the wall? That's PECS!" "No, those are just pictures on the wall."). At times, *PEC* becomes synonymous with *picture*, as in "He gave me the PEC for soda." This confusion is compounded on the Internet, where advertisements can be found promoting "buy your PECS here!" only to lead to a site selling various pictures and icons. Indeed, there are other ways that pictures can become part of a helpful system for children and adults with disabilities, especially with regard to receptive/listener skills. However, PECS involves teaching individuals to use pictures (icons, photographs, logos, 3D representations, etc.) to engage in verbal behavior, by initially using the mand and then moving on to the tact and intraverbal. Furthermore, there is a distinct protocol associated with PECS, and this protocol is followed in research demonstrating the effectiveness of PECS. PECS is clearly not simply the use of pictures (see Rehfeldt & Barnes-Holmes, 2009).

If We Are Using a Picture Schedule, We Are Using PECS

Teaching people to use visually mediated schedules and other similar systems is a well-supported strategy (McClannahan & Krantz, 1999). However, it is the teacher/parent who puts the pictures on the schedule, and users are taught to respond to those pictures. Thus, schedule following is a listener, or receptive, skill. Although some have reported that they have observed children taking such pictures and use them as mands, this outcome is not systematically taught and appears via underresearched mechanisms. Perhaps, over time, research in stimulus equivalence will help set guidelines for teaching the use of pictures in multiple functions.

PECS Is Only for Young Children

The protocol for PECS was developed with young children with autism. However, there are now at least nine studies demonstrating the effectiveness of PECS with adults. These studies include Chambers and Rehfeldt (2003), Conklin and Mayer (2010), Rehfeldt and Root (2005), Stoner et al. (2006), Wood, Luiselli, and Harchik (2007), and Ziomek and Rehfeldt (2008). Each has demonstrated that PECS can be a viable communication system for adults with a variety of communication handicaps. Ziomek and Rehfeldt commented, "These results suggest that PECS may be a viable alternative communication system for adults with severe developmental disabilities who have little or no history of systematic instruction and limited imitative repertoires" (p. 15). The work by Rehfeldt has been especially elegant, with excellent examinations regarding generalization issues following the acquisition of PECS, including demonstrations of derived manding and displays of untrained tacts and intraverbals. Hopefully, this type of research will continue to clarify for whom PECS is best suited and what other repertoires PECS use may influence.

PECS Is Only for Those With Autism

This bias is best dismissed by pointing out that there have been numerous publications involving children and adults with non-autism diagnoses. These other disabilities include developmental disabilities and multiple disabilities (Ali, MacFarland, & Umbreit, 2011; Bock, Stoner, Beck, Hanley, & Prochnow, 2005; Chambers & Rehfeldt, 2003; Rehfeldt & Root, 2005; Stoner et al., 2006), as well as conditions such as cerebral palsy (Almeida, Piza, & LaMonica, 2005), blindness (Lund & Troha, 2007), and deafness (Okalidou & Malandraki, 2007). There also is research on modifying the pictures to accommodate the needs of a blind communicative partner (Charlop, Malmberg, & Berquist, 2008). Of

course, more research is needed to demonstrate the extent to which PECS can benefit those with various communication difficulties.

You Can Only Communicate About the Picture You Have

The argument here seems to be that a user can only communicate about things for which specific pictures are available. That is, if a child does not have a picture of a truck, then she will not be able to ask for or comment about trucks. Children who speak and sign are said to be capable of using "generative language." However, there is clear research indicating that users of the PECS protocol can also use improvisational skills (Marckel, Neef, & Ferreri, 2006). Furthermore, Chaabane, Alber-Morgan, and DeBar (2009) extended this line of research by showing that parents were effective in teaching this skill to their children. In these two studies, PECS users requested items for which they had no corresponding picture by using other pictures in their repertoire, for example, using "I want eat white circle" to request a marshmallow. Therefore, having a picture for every item in every situation is not essential for PECS users, as generally is the case for children who use speech or sign language. Of course, explicit training on this problem-solving strategy is likely to increase the probability that this skill may emerge.

A side effect of this misconception may account for situations in which parents (or teachers) place hundreds of pictures in a child's communication book "just in case." In such situations, the communication book functions more like a dictionary listing of all potential pictures than a selection of functional vocabulary based on the user's preferences, history, and immediate environment. Furthermore, when this strategy is implemented before discrimination skills have been acquired, there is likely to be a high rate of errors.

Only Simple Requests Are Possible via PECS

As noted, the first lessons in PECS do focus on the request/mand function. Even when some teachers move on to sentence structure, it is often observed that the only use of the system is to ask for single items with an accompanied "I want" sentence starter. This limitation is problematic for a number of reasons. First, while typically developing children's vocabulary (i.e., the number of words spoken) grows over the course of the first several years, so too does the complexity of their sentence structure. Sentences become longer not only because multiple items may be requested or commented on but also because attributes and other qualifiers are adding additional qualifying features of language. So, too, should the vocabulary of a PECS (or any AAC) user grow in terms of both the number of pictures in the total repertoire and the length and complexity of the sentence structure.

Another factor that may lead to overly simplified responses involves some practical limitations on expansions that teachers may create unintentionally. In one group home for adults with severe developmental limitations who were recently released after years of institutional life, an adult made exceptional communicative progress after PECS was introduced. During one observation of the group home, after completing some household chores, he went to the kitchen area with a sentence strip showing two icons, "I want… coffee." The staff member showed a pot of coffee; the user constructed a new sentence, "I want…mug." He was brought a mug, and then he constructed, "I want…sugar," and so on. Did this use of pictures reflect a limitation on the user's part, or was it related to how staff created opportunities to communicate? His sentence strip had only two Velcro dots, and this in turn limited the length of his request. Upon being given a long sentence strip with a continuous Velcro strip, he asked for the entire set, just as we would when we go to our local coffee shop. At times, the repertoire of any communicator may be limited or even undermined by staff who are not aware of placing those limitations on the user.

In many other programs, severe limitations of the use of attributes is observed because of an apparent belief that these skills reflect cognitive concepts that may strain the abilities of some users. One team argued that a young man could not understand *big* versus *little*

because he had failed to make progress on this skill over the past 10 or more years. However, given his first opportunity to use his pictures to request a big versus a small cookie, he demonstrated mastery of this skill.[11] Why the change? Virtually all of his educational lessons regarding *big/little* were restricted only to receptive/listener skills ("Show me the big one"), which also invariably led to social consequences ("Nice work! You're right!"). Such statements were not functional reinforcers. Of course, the user's history with cookies led him to experience big ones as more reinforcing than little ones; hence, his PECS-based request for *big* resulted in immediate reinforcement. The argument is not that PECS per se led to this change, but rather that the introduction of manding via PECS permitted more functional reinforcers to become available for a variety of lessons.

Is there a limit on the complexity of a PECS sentence? Perhaps, but in one situation, a young boy constructed, "Can I have a cup of water? I want to cook a Pop-Tart in the toaster." The upper limit of such constructions has a great deal to do with the expectations and environmental arrangements created by teachers.

If a User Asks for Something With PECS, We Must Always Honor It and Risk Producing a "Spoiled Brat"

Part of this concern stems from the encouragement during the initial phases of PECS to provide a rich schedule of reinforcement for appropriate requests. Thus, in Phase I, a teacher might provide scores, if not hundreds, of trials for manding, perhaps using small portions to minimize satiation. However, just as users of any other modality of communication, including speech, must at some point, users of PECS must learn that they cannot get exactly what they want the moment they want it. Thinning a schedule of reinforcement is a necessary consequence of natural and social environments. That is, at times a child cannot have another cookie, perhaps because he has eaten them all. Nature may intervene by raining on the wanted parade. At other times, the teacher may choose—for a variety of reasons, including being momentarily "mean"—that he or she will not honor the request. Sometimes, someone else is playing with the only toy the child enjoys. It may not be simply a case of teaching the child to tolerate the occasional "no." Perhaps the true meaning is "later" (short-term, as when waiting for the toaster to finish, or long-term, as in "we'll ride the tricycle after we go to the playground"); perhaps we are willing to give another cookie only after some more work is done ("Let's make a deal"). All of these and other lessons that make up the full Pyramid Approach must accompany PECS in order for its use to be fully functional in multiple environments with a variety of people, just as is the case for each communicative modality or system.

PECS Is Only for Those Who Have No Speech, and PECS Will Prevent the Development of Speech or Interfere With Any Current Speech

An answer to the first issue here was actually addressed in the discussion on when PECS should be introduced. But in this case, the issue is related to the single biggest fear associated with the use of PECS: What about speech? One part of this issue relates to the perspective that not all speech production represents functional communication. In other words, it is possible to engage in vocal behavior, even elaborately so, without displaying verbal behavior. If vocalizations are not under the stimulus control of a listener and if the subsequent reinforcers are not mediated by that listener, then verbal behavior has not occurred. Thus, some children may be vocal and profit from using PECS because it is a good avenue for acquiring verbal behavior.

As noted earlier, the issue of initiation remains pertinent. Many people have noted a significant paucity of spontaneous communication in young children with autism (Koegel, Carter, & Koegel, 2003; Stone & Caro-Martinez, 1990). The verbal repertoire of many

11 On subsequent occasions, he demonstrated the appropriate use of *little*, thus demonstrating discrimination between the two attributes.

young children with autism and related disabilities may be limited by specific prompts or other signals by teachers; that is, a child may say "apple" only in response to "What do you want?" or "What is this?" In such cases, there may be no pure mands or tacts in the verbal repertoire as long as the verbal behavior of someone else remains part of the controlling environment. As has been noted, the PECS protocol seeks to establish requesting in the absence of teacher statements very early in the sequence of lessons. For such children, PECS may help with factors such as "when to use your words," as opposed to fostering the initial development of spoken words.

In terms of clinical practice, waiting for parents or staff to raise this issue of fear concerning speech would not be advisable. The professional who makes the recommendation about PECS as an appropriate initial communication strategy should anticipate this fear and immediately provide information regarding the complete lack of evidence over a substantial number of years that PECS or any other AAC system has interfered with or impeded the development or expansion of vocally based communication (see Schlosser & Wendt, 2008, for a review of these issues).

You Can't Do PECS and Verbal Behavior!

During the early years of describing PECS, it was surprising to encounter resistance with regard to whether PECS was consistent with an ABA approach. More recently, a number of behavior analysts have made the above statement, in various forms. Heated discussions about the relationship between PECS and verbal behavior can escalate to the point of absurdity, including statements such as "PECS is not verbal behavior!" What could they mean by this assertion? A historical perspective may help clarify the issues.[12]

Although Skinner was a prolific researcher, the book *Verbal Behavior* contains no explicit studies and thus no data produced by experiments conducted by Skinner. Furthermore, there is no "how to" section—there are no chapters in the book along the lines of "how to teach a child to ask questions" or "how to teach a child with autism to engage in verbal behavior." Rather, the book offers an analysis of what the general public would view as communication and language from a behavioral perspective. It is that analysis that makes the book so unique and invaluable. Unfortunately, many of the core ideas and terminology developed by Skinner were not immediately adopted by speech–language pathologists or even by behavior analysts. Over the years, a few voices continued to stress the importance of the book, especially Michael (1985) and Sundberg and Partington (1998). Over time, Sundberg and Partington began to describe in detail how the analysis offered by Skinner could help guide assessment and lesson development for those displaying difficulty acquiring speech in natural environments. More recently, some have developed a package of strategies that purportedly is based on Skinner's work, and it is this package that is generally referred to as AVB (applied verbal behavior). Unfortunately, many misattribute AVB to Skinner, as demonstrated in this quote from one Web site: "The subspecialty of ABA...is Applied Verbal Behavior (AVB), which was developed by B. F. Skinner" ("ABA/AVB," n.d., para. 2).

So, what is AVB? First, it is not easy to begin to answer this question, in part because of the paucity of research, especially outcome research on the overall package. Barbera (2007) gives credit to Sundberg and Partington (1998) for publishing an assessment tool, the Assessment of Basic Language and Learning Skills (ABLLS), as part of an anchor for the verbal behavior approach (see also Barbera, 2009). Recently, Sundberg (2008) produced the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP), while Partington (2006) published a revision of the ABLLS (the ABLLS-R). Both are self-described as assessment tools, curriculum guides, and skill-tracking systems. Only time will tell if one or the other will provide a better guide to effective learning, as both offer

12 It should be noted that there are other approaches that are built on the work of Skinner, such as that developed by Greer and Ross (2008), using the acronym CABAS. The comments in this section on applied verbal behavior are not intended to be associated with the CABAS model.

refinements to assessment and suggestions on content areas. Much of the communication about AVB as a distinct package has been conveyed through workshops and Web sites. One published description of the approach is based on one author's attendance at such a workshop, and it will be used as a guide to the key components of the AVB package (see Kates-McElrath & Axelrod, 2006, for details regarding the contents of the workshop and the elements of the package).

In the review by Kates-McElrath and Axelrod (2006), it is first noted that the curriculum relies on the ABBLS (or its updates). Next, there is an emphasis on "positive reinforcement," accompanied by comments that more traditional ABA approaches rely too heavily on "negative reinforcement." This distinction is not backed up by data; it is anecdotal in nature. There is then an emphasis on what is described as a "natural" environment approach. This orientation appears to place great emphasis on strategies the field first associated with incidental procedures. Within this area are recommendations for ensuring a fast pace, which is often referred to as involving "fluency." The use of the term *fluency* is problematic in that this term is associated with direct instruction or precision teaching and refers to rates of behavior essentially controlled by the learner, not the teacher. A teacher can set a fast pace by controlling the presentation rate of various discriminative stimuli. Setting a fast pace may indeed be beneficial, but it alone may have no impact on fluency. Similarly, children may be prompted to mand an item a set number of times within a session, purportedly because this strategy would promote fluency. Here, too, the research on fluency does not support this as an effective technique (for more on teaching fluency, see K. R. Johnson & Layng, 1994). There also is an emphasis on avoiding "blocks of trials" and, instead, interspersing trials of varying difficulties and stimuli. The occasional loose use of terms adds to the difficulty of determining whether aspects of the package are related to Skinner's analysis of verbal behavior or are simply components of virtually all effective ABA packages.

Within a discussion of prompting, there is an emphasis on "errorless learning." This terminology was first noted in the experimental area (Terrace, 1963), and strategies related to making very small changes in teaching protocols have been deemed to be *errorless* (see Touchette & Howard, 1984). However, it is not clear from the literature whether a teacher can truly eliminate all possible errors in either discrete or sequential lessons. Thus, within AVB, despite the best efforts of the teacher, when errors do occur, particular error-correction strategies (distinct from the no-no-prompt style associated with Lovaas-based ABA lessons) are recommended (see J. Leaf, Sheldon, & Sherman, 2010, for an example of research using no-no prompting). However, empirical support regarding the efficacy of these specific strategies is currently lacking, as is information about whether they are more effective than other methods, traditional or not. Emphasis also is placed on what are explicitly called "rapid stimulus transfer procedures." It is not clear if the authors are implying that more traditional approaches have used procedures that are essentially "slow" in nature. Minimizing errors during teaching is always a good idea (see Mayer, Sulzer-Azaroff, & Wallace, 2011). There also are a host of rules about data collection promoting the idea of "data probes." In short, many of the strategies that are described as central to the AVB package are not found in Skinner's book.

The hallmark of the AVB approach is its attention to the verbal operant analysis offered by Skinner (1957). There is a clear emphasis on beginning with the mand and distinguishing it from the tact and the intraverbal. Relatively little attention is noted about the autoclitic. However, there is a consistent and unequivocal emphasis on sign language, should the development of vocal verbal behavior be problematic. How fervent are the admonishments not to engage in use of PECS? Obviously, the true rate is difficult to assess, but a recent posting by a mother of young child on a chat group whose mission is to focus on AVB demonstrates some cause for concern: "Hi, my school went from traditional ABA to verbal behavior. The issue I have is that he had a PECS book and he is now not allowed to use it in that classroom because the teacher told me that verbal behavior is sign language and verbal" (Trilla, 2008). Certainly not every proponent of AVB would encourage such an

action, but this orientation by some appears to be linked to issues associated with sign language, an area I will shortly review in greater depth.

All broad strategies develop certain practices that may be best considered rituals; that is, they are used by practitioners in the absence of data and in adherence to a minor aspect of theory. For example, many teachers use the instruction "match," as in "match horse," meaning "put this picture of a horse on the toy horse," without any evidence that this is more effective than more natural but simple statements such as "put with horse." Within the AVB approach, there is the danger that descriptions of verbal operants may replace sound reasoning about the structure of a lesson. For example, a speech–language pathologist asserting that she was well trained in using the AVB model was observed teaching a lesson to a young child with autism who had a fair degree of vocal verbal behavior. She was interspersing a series of tasks among which was the statement, "Say, 'I need help.'" The boy complied with the statement. This scenario was repeated many times within the 15-min lesson. When asked why she was doing this, the instructor replied, "We're developing an echoic and later will use rapid stimulus transfer procedures to shift control to a functional context." While the description of the plan was accurate, there seemed to be no recognition that this was a very poorly designed lesson, which a better understanding of Skinner's analysis would quickly reveal. Skinner made it clear that we learn to tact private events, such as commenting about our emotions, while we are experiencing those events. The audience uses public accompaniments and collateral responses to tell the child what he is feeling, and then the child via generalization of the echoic can describe that feeling at other times and places. But it is clear that it is the echoic in context that leads to generalization, not the out-of-context lesson just described. A child learns to ask for help in situations—contrived, captured, or otherwise—in which help is required to solve the immediate situation (see Durand & Carr, 1991). Using a descriptive language of verbal operants provides no guarantee that the lesson itself will be functional and effective.

You Can't Mand With a Picture…You Can't Engage in an Intraverbal With a Picture…

It has been argued that pictures cannot reflect true verbal behavior because all that is involved is matching-to-sample (e.g., a child sees an apple and picks up the picture of the apple). A deeper analysis suggests that matching-to-sample is not verbal behavior because the listener (audience) does not set the occasion for the behavior and does not mediate reinforcement in order to develop verbal behavior. On the other hand, could a repertoire of matching-to-sample influence one's use of pictures within PECS? Of course. Consider vocal verbal behavior development for a moment. An imitative repertoire may in fact influence the echoic, but imitation per se is not verbal behavior, while the echoic is a verbal operant. Skinner was very careful about this issue in the chapter on the echoic in *Verbal Behavior* in that he provided a rather unique section on "What echoic behavior is not" (Skinner, 1957, p. 58). Although a child may "automatically reinforce his own exploratory vocal behavior," and this may be "important in the automatic shaping up of standard forms of response," Skinner noted, "this is not echoic behavior, however, because a verbal stimulus of corresponding form does not immediately precede it" (p. 58). Automatic reinforcement may help shape vocal behavior, but verbal behavior involves reinforcers mediated by others. Later in the same chapter are examples of imitation that are not equivalent to the echoic. Imitation may influence the echoic, but it is not the echoic. Therefore, when a child uses a picture, can the response be influenced by a matching-to-sample repertoire? While such influence may be true, it is not necessary. That is precisely why behavior analysis does not rely on simply the behavior itself—a complete functional assessment of the sources of control is required. Such an analysis may indeed demonstrate that one particular use of a picture conforms to the definition of *verbal behavior*, while another conforms to matching-to-sample.

The argument associated with the issue of the intraverbal is somewhat more complicated. For example, imagine a teacher says, "I'm thinking of an animal that has a long tail,

lives in the forest, and starts with *m*. What is it?" and a speaking child replies, "It is a monkey." This response is viewed as an intraverbal because the stimulus is the verbal behavior of someone else (without the confound of some corresponding aspect of the environment, like a monkey in the room), the response form is not influenced by the form of the stimulus, and the reinforcer is educational (social). However, if the child responds by putting together a sentence strip with "It's a…monkey," it has been argued that this response is not an intraverbal because the child is merely responding to the picture of the monkey. Before attempting to determine whether this argument is cogent, consider some other examples.

The telephone rings, and someone answers it. What is the discriminative stimulus (S^D) for answering the telephone? It is not the telephone; rather, it is the ringing of the telephone. What, then, do we call the telephone in this example? It is a manipulandum—it permits defining the response of "answering the telephone"—but it is not the S^D for the response.[13] Can the form of the telephone influence characteristics of the response? Of course, a cell phone is handled differently than a landline phone. Of course, the telephone can serve as an S^D for other behaviors, and events other than ringing—perhaps vibration—can act as an S^D for answering. It is herein suggested that the same analysis can be applied to the use of pictures.

Pictures can serve as S^Ds for certain acts, but in the monkey example above, what is the S^D for the child's verbal behavior? It remains the verbal behavior of the other person, and the form of the response bears no one-to-one correspondence with the form of the stimulus. What is the role of the picture of a monkey in the child's communication book? It is a manipulandum; that is, it permits defining the response of using pictures to engage in verbal behavior. At what point does the child "make contact" with the picture of the monkey? Somewhere in the full response chain. The picture of the monkey is not part of the stimulus. The teacher's verbal behavior is the relevant stimulus (along with the aspect of being an audience for the child).

A related argument suggests that the pictures in PECS can be used in a mand but not an intraverbal function. This argument asserts that a particular response form—selecting and giving a picture to someone else—can serve one verbal operant function but not another. As noted, verbal operants are distinguished by their controlling variables, not by anything inherent in the response itself. A *mand* is defined by a particular arrangement of antecedents and consequences; when the antecedent and/or the consequences are changed, a new behavior, or behavioral unit, is defined. This breakdown is one key feature of Skinner's analysis. How would we define the verbal operant associated with the spoken sound configuration "cookie"? That depends on the antecedents and the consequences. It can serve as a mand, tact, intraverbal, or echoic, or it could be controlled by multiple sources. Arguing that a particular response (or response form) may serve as one operant—a mand—but not another operant—a tact or intraverbal—refutes the basis by which operants are defined. If a particular behavior—giving a picture—can function as a mand, it also must be viewed as potentially functioning as any other verbal operant.[14]

Topographical Selection Systems Are Better Than Stimulus Selection Systems

In 1985, Michael introduced the terms *topography-based* and *stimulus selection–based* verbal behavior. In topography-based examples, forms of response—speaking, moving fingers (as in sign language)—are differentially reinforced to establish a variety of verbal operants. In stimulus selection examples, someone points to, picks up, or in some way interacts with a stimulus such as a picture, printed word, visual icon, or so forth. This

13 I remain indebted to Rick Shull, who taught this invaluable lesson while I was in graduate school. I was at a loss to describe the key that a pigeon comes to peck, especially in cases when lights are functioning as discriminative stimuli. The key is a manipulandum; it is not the discriminative stimulus.

14 Perhaps "overt verbal operant" is more precise, as the autoclitic may have certain special properties.

initial short paper pointed to a number of variables that might distinguish between the two types of verbal behavior and thus might influence the rate of acquisition. Since that paper, there have been numerous others addressing questions such as, Which is better—topography-based or stimulus selection–based systems? (See Potter & Brown, 1997, for one example.)

In the field of AAC, the terms *aided systems* and *unaided systems* have been used since the early 1980s to essentially describe the same issues (P. Mirenda, personal communication, January 20, 2011). That is, the use of speech or sign language is described as "unaided," while the use of PECS, SGDs, or other icon-related systems is "aided." In the broad field of AAC, there have been many publications regarding the limitations and benefits of each (Mirenda 2003).

Predating each of these distinctions are discussions in psychology related to *recall memory* and *recognition memory*. For example, a multiple-choice test is said to rely on recognition memory, while an essay test would involve recall memory. Here, too, there is a rich history of research regarding this distinction and how to best improve either type of skill. For example, if someone reports getting confused by the choices on a multiple-choice test, one recommendation would be to change the task into something resembling a recall task; that is, read the question but cover the answers and try to recall the answer before looking for it. On the other hand, for someone who has difficulty organizing an essay, one strategy may involve writing down all the potentially necessary relevant facts—critical names, dates, and references—and then reading the question and looking for the information previously written down. In short, although there are many examples of strategies to improve one type of memory over the other, few would seek to answer in an ultimate sense the question, Which is better—recall or recognition memory? However, that appears to be precisely what many are trying to do by looking for an answer to the questions, Which is better—aided or unaided communication? and Which is better—topography-based or stimulus selection–based verbal behavior?

It may be helpful to recall that Skinner (1966) asserted that "the form of response seldom if ever yields useful classifications. The verbal response *Fire!* May be a command to a firing squad, a call for help, or an answer to the question, *What do you see?* The topography tells us little" (p. 6). Within a classification, or operant class, variations in form/topography can be indicative of different behaviors. However, the operant is defined by the full three-term contingency, and the success of the verbal response is defined by the listener.

In order to arrive at an absolute relative benefit of topography versus stimulus selection systems, all other variables would have to be held constant. That is, how a response is taught in the two systems would have to be identical. Otherwise, if we were to find that System A was better than System B, one simple explanation could be that System A was taught using very effective strategies, while System B used weak strategies. To reiterate and emphasize, the use of pictures to mand could be taught using very effective teaching strategies. Similarly, the use of sign language could be taught using very poor teaching strategies. In this scenario, the use of pictures would likely appear superior to the use of sign language, but would this truly reflect the differences in the modalities themselves?[15]

At issue is whether the prompts and prompt elimination strategies for two distinct modalities can ever be viewed as equivalent. Physical prompts may be used to prompt picking up a picture. However, as noted earlier, distinct sounds are not readily physically prompted. It is possible to use shaping to modify vocal production or hand/finger movements. However, it would also be possible to use shaping to gradually modify a child's hand motions to help him or her pick up a picture. What is questionable is whether these prompts and shaping procedures are identical or at least can be viewed as equivalent in some pertinent dimension.

15 It is interesting to note that several attempts to compare PECS with either sign language or electronic devices have used the PECS teaching protocol to teach the other strategy; that is, there is an attempt to follow the phase structure, skill differentiation, and teaching strategies specified for PECS.

Without this seemingly ultimate answer, a better use of resources would involve seeking to determine the most effective teaching and error-correction strategies for all potential communication strategies and systems. Furthermore, it may be beneficial to determine whether there are any behavioral characteristics, including early indicators of rate of acquisition, that may help in the best fit of a communication system to an individual user.

Another perspective can be taken by looking at whether the distinction between the two is truly simple and clear. Catania, Sveinsdottir, DeLeon, Christensen, and Hineline (2002) offered a humorous questioning of the utility of the distinction. They noted,

> Given the histories of the terms *topography* and *selection* in behavior analysis, these vocabularies set the stage for potential theoretical and pedagogical problems, because topography-based verbal behavior is taught by shaping, which is a variety of selection, and selection-based verbal behavior may be taught using stimuli that vary in topography. (p. 81)

Perhaps a few examples can illuminate this concern. Imagine someone finger spelling the word *cookie* in the air as a mand for a cookie. Finger spelling would be characterized as topography based. Now the individual performs the same motions but lightly touches a sandy surface—the indentation barely lingers because of a strong wind. Still, this performance would be viewed as topography based. Now the person dips a fingertip into paint and performs the same motions lightly touching a piece of paper—the paint leaves a clear mark. Still, this would be topography based. But now the same person simply picks up the piece of paper and hands it to someone else as a mand for a cookie. At what point did this become stimulus selection based? Perhaps attempting to split hairs is neither necessary nor illuminating.

However, other performances may be more directly related to the issue of functional communication. Let's consider a case that moves in the other direction from the previous example. In learning how to use a keyboard, we begin by looking at each key before selecting it by pressing it. This skill involves a type of stimulus selection–based performance. However, over time, we learn to type while looking at the materials to be copied and not at the keyboard. This performance would now seem to be topography based. Correct performance relies on finger position independent of visual guidance to the keys. Should we try to determine when this transfer occurred—was it a quantum leap or a gradual transition?

This same issue happens with those using PECS (or many other icon-mediated systems). That is, early in discrimination training, the user looks at each picture before it is selected for exchange. As part of refining the discrimination, the pictures would not have a fixed location, thus demonstrating that it is the content of the picture and not its relative position that guides selection. However, over time and for speed of access, many users have communication books (boards or electronic presentations), wherein the pictures are fixed in position (i.e., the "I want" icon always is in the upper left-hand corner of the first page). In such cases, many users can be observed to flip through the book, accurately selecting pictures to be placed on a sentence strip without looking at some of the pictures—they appear to know where the picture is. Moving hands in a particular pattern, although not guided by any external signals (e.g., the contents of the particular picture), would appear to meet the description of topography based. Thus, over time, just as the use of a keyboard can become stimulus selection based or topography based, so too can the use of icons in a picture-based communication system.

In trying to distinguish speech and sign language from PECS use, some have noted that each response in speech and sign language involves unique movements, whereas movements required for PECS are identical across pictures. That is, each spoken word or sign can be differentiated by a specific and unique motor performance, whereas each and every use of PECS only involves handing someone a picture. An analysis of motoric variations correlated to different speech productions would suggest often subtle modifications of the movements of the larynx, lips, mouth, and other aspects of the vocal tract. Similarly, an analysis of different signs would suggest often subtle variations in the

configuration and movement of the fingers, including movements of the arm and other parts of the body. The performance of interest in the use of PECS begins with orienting to the pictures, selecting the pictures, picking them up, and handing them to the communicative partner. Consider what is involved in picking up a small icon amidst other small icons—it involves often subtle modifications of the movements of the fingers, arms, and perhaps shoulders. Without such subtle variations in movement, there would be no demonstration of discrimination. It is true that the final aspect of the performance is similar in each case—put the picture into someone's hand. Focusing only on the last aspect of speech production would suggest all productions are the same because they end with the exhalation of air from the lungs. Obviously, this too would not offer a complete analysis of the behavioral set. When comparing across modalities, it is important to analyze the complete response production, as each production is subject to its own set of contingencies.

Another example focuses on the role of the audience. The role of the communicative partner is central to the definition of verbal behavior. When we speak on the telephone, we assume there is a live person on the other end of the line. When we use a video connection on our computer, again we assume that what we see and hear through the connection is attributable to a live person. But is this assumption necessary to define verbal behavior? Imagine that there is a delay between speaking and getting a reply, perhaps because of a poor connection (or because the other end of the line is on the moon). You speak and either hear or see a reply. Is the form of the reply topography based or stimulus selection based? We assume that if we hear a reply, it was topography based. However, if the other person used a machine to construct the response—that is, the other person selected from an array of potential responses the appropriate machine speech-generated answers—then our assumption would be faulty. Assume that you used sign language, whereas the other person appeared to sign in reply but in fact used a holographic "person" to sign back, thus using a type of stimulus selection process to produce signs. The point is, Would you be able to verify how the other person constructed their response? Does your inability to be sure of how their response was formed change how the conversation will progress? In other words, whether the other person used topographical modifications, selection-based modifications, or some combination would not alter the fact that verbal behavior was occurring.

Sign Language Is More Effective Than PECS in Promoting Functional Communication; Sign Language Use Has a Higher Probability Than PECS to Promote the Use of Speech

As noted earlier, although there are many individual studies supporting the use of sign language in autism, there also are those who question its effectiveness, either as a means of functional communication or as an aide in the development of speech. However, the issue here is the relative effectiveness of sign language as directly compared with PECS in terms of empirical outcome and theoretical underpinnings. First, it should be noted that there are very few studies that directly compare the two modalities. Some have involved individuals with autism, whereas others have involved those with developmental delays. There is little in the literature to suggest that any AAC system has a differential effect related to specific diagnoses when supported by strategies developed within ABA.

Those promoting an AVB approach cite several studies as supportive of their emphasis on encouraging the use of sign language prior to the use of PECS when speech is slow to develop. One study (Tincani, 2004) used an alternating treatment design with two school-age children with autism. In the sign language training, the PECS protocol (using two trainers for the first phase of training) was adopted. Both children were reported to vocally imitate but not use speech as a communication modality. In the sign condition, rewarding items were presented along with models of associated signs and speech. Furthermore, a progressive time delay (increasing to 4 s) was introduced

between item presentation and sign/vocal modeling. In the absence of the sign by the child, a physical prompt was provided by a second trainer; this was intended to parallel the PECS protocol. In the PECS condition, no modeling was used; rather, the protocol was followed to provide a physical prompt from a second trainer regarding the physical exchange of a picture when presented with a rewarding item. The study was discontinued after discrimination training—Phase III of the PECS protocol—was mastered. There were clear procedural differences between the two training conditions—one involved vocal modeling, whereas the other did not. For one child, the use of the sign/vocal model undermined initiation and was therefore replaced with direct physical prompts to guide the formation of the sign. Furthermore, although it is noted that 10 to 12 preferred items were used for each learner, there is no report of how many signs or pictures were mastered. Instead, a percentage-of-independent-mands measure was used. In terms of vocal development, a similar percentage-of-word-vocalizations measure was noted. One child demonstrated a higher percentage of signs than pictures, whereas the other child showed the opposite effect. One child vocalized more during the sign condition, whereas the other child demonstrated an interesting pattern. This child, who demonstrated better use of PECS than sign language, demonstrated consistent vocalization while signing. Her spoken word use within the PECS condition was initially high but then dropped until the procedure used to promote sign use—the delayed reinforcement strategy—was introduced for vocalization. At that point, her percentage of word vocalizations in the PECS condition returned to the same previously high percentage. On one Web site promoting AVB, one outcome is noted as "sign language was superior to PECS in supporting vocalizations" (Carbone Clinic, n.d.). On another site, the outcome is summarized as follows: "For both children, sign language training produced a higher percentage of vocalizations during training" ("American Sign Language," n.d., para. 16). When professionals make such sweeping misrepresentations of data, it is not surprising that others come to view such biases as empirically based.

The second study frequently cited in AVB is an unpublished doctoral dissertation by Anderson (2001). In this study, six children with autism, ages 2 to 4 years, were taught both PECS and sign language. Modifications were made to the sign language condition to approximate the PECS protocol, including the use of two trainers in the first phase of training. Modeling and physical prompts to support signing were accompanied with spoken models, although this was not used in the PECS condition. This study also ended after discrimination was mastered. The outcomes included the following: (1) all children acquired more pictures than signs; (2) three of the children learned only two signs, and the maximum number of signs for a child was five; (3) each child learned more than five pictures; (4) only three children vocalized, doing so in both conditions, and produced more vocalizations during the signing conditions. The analysis also involves an unusual attempt to define a child's preference. This was defined by noting that three children occasionally (14%, 8%, and 6% of the time, respectively) signed while pictures were available; of course, no child could use PECS when pictures were not available. However, each child learned to use more pictures than signs given equal training opportunities. It should be emphasized that this study involves very small repertoires—no more than nine pictures or five signs for any child. Despite these tiny repertoires, many have made rather sweeping conclusions to the effect that this study clearly demonstrated that sign is more effective than PECS in supporting vocalizations.

A critical limitation of each of these studies is that only a portion of the PECS protocol was used. Both studies ended with discrimination training and thus did not attempt to use the strategies in Phase IV that best support the encouragement and reinforcement for vocalization. Studies by Charlop-Christy et al. (2002), Ganz and Simpson (2004), and Tincani et al. (2006) all noted increases in vocalization in Phase IV. The Tincani et al. study emphasized the role of the delayed-prompt strategy in that phase. It would seem necessary that studies looking at the effects of PECS on speech should be viewed as comprehensive only if they attempt to complete the protocol.

Furthermore, there are several studies comparing the use of PECS and sign language that demonstrate different outcomes. For example, Adkins and Axelrod (2002), using a single-subject design for a child with pervasive developmental disorder, concluded, "The use of PECS…produced a better acquisition rate, more spontaneous usage, and a higher generalization rate than the use of sign language" (p. 264). A study by Chambers and Rehfeldt (2003) compared PECS training to manual sign training with adults with severe developmental disability and found better acquisition rates and generalization, including when requesting items that were not present, for the PECS condition. In a more comprehensive comparison, Ziomek and Rehfeldt (2008) also taught both modalities to adults with severe developmental disabilities and made several conclusions:

> Mands for preferred items and for items needed to complete a chained task were acquired more rapidly and in fewer training blocks for PECS than for manual sign. Moreover, mands established using PECS generalized across settings and communicative partners. Finally, untrained tacts and intraverbals using PECS were shown to emerge for some of the participants following PECS training. (p. 15)

The latter two studies did not involve autism; they did target a population displaying markedly impoverished verbal repertoires.

So, is there a clear advantage to teaching sign language over PECS? A review of all the relevant literature does not support this conclusion. It is hoped that future discussions of this issue will consider all the relevant available data. Selection of an effective modality involves many complex issues, and we are currently far from developing evidence-based guidelines for individuals to benefit from such dichotomous argumentation. Our clinical challenges in how best to teach effective verbal operants in a variety of modalities remain steep and are further complicated by issues related to transitioning between any two modalities. More research is needed to further outline best practices in these areas.

As noted, it is not possible to provide a universal answer to such comparisons because the teaching strategies cannot be separated from the modalities. Ziomek and Rehfeldt (2008) noted, "Moreover, with so many variables, such as the prompting and prompt reduction techniques differing between the two procedures, it is difficult to set up a fair comparison of PECS versus manual sign" (p. 27). This statement is equally true for comparing any two complex instructional systems. Perhaps the field will focus more on answering questions that relate to the most effective way to teach each potential modality or system. Furthermore, efforts to focus attention to universal advantages of one modality over another seem to take us away from the functional emphasis that Skinner promoted in *Verbal Behavior.* His insistence that a definition of verbal behavior is not dependent on form, mode, or medium is demonstrated quite early in the book, perhaps to rapidly derail such nonfunctional comparisons.

Comparing PECS to Other Broad Intervention Packages

There have been a few attempts to compare the PECS protocol with other communication intervention packages. In a series of studies, Yoder and Stone (2006a, 2006b) used a randomized group experiment with 36 young children with autism to compare PECS training with their own package, Responsive Education and Prelinguistic Milieu Teaching (RPMT) over a 6-month period. Among many findings, "PECS was more successful than RPMT in increasing the number of non-imitative spoken communication acts and the number of different non-imitative words used at the post-treatment period" (Yoder & Stone, 2006a, p. 698). Part of their analysis looked at whether preintervention variables would influence skill development with either approach. In a subsequent analysis of these same children, Yoder and Lieberman (2010) looked at an outcome measure described as "far-transfer," which involved changes in the examiner, setting, activities, and materials from those used during treatment. They concluded the following:

> Post-treatment measurement of the number of picture exchanges in a far-transfer assessment context favored the PECS intervention. These findings were interpreted as support for the hypothesis that the PECS curriculum can successfully teach a generalized means of showing coordinated attention to object and person without requiring eye contact to children with ASD. (p. 629)

In another comparison, Schreibman (2008) described preliminary results on comparing the PECS protocol to Pivotal Response Training (PRT) for 39 very young children (24 to 48 months) with autism who were randomly assigned to the two groups. A key behavioral characteristic was that each child used fewer than 10 spoken words upon entry into training. Intense training was provided over a 6-month period, including an intense parent-training emphasis. While many of the teaching strategies are identical and all strategies are based on ABA, PRT is a vocally directed program. One (of many) outcome measures involved parental report via a standardized inventory regarding the number of spoken words used. At the completion of training, there were no significant overall differences between the two groups on the number of spoken words (though, in both groups, children who displayed no words upon entry acquired the fewest number of spoken words). Furthermore, there were an equal number of children in both groups who did not display any spoken words at the end of the intervention. Those children who were in the speech-only group essentially had no functional communication skills 6 months after intervention began. However, although the same number of children in the PECS condition did not acquire speech, each child did acquire a functional communication repertoire via pictures. Thus, focusing solely on speech production for a child with autism in this age range, displaying no speech may place that child at risk relative to combining speech approaches with PECS, which can provide a functional communication set independent from speech.

Conclusion

PECS was developed in the field of ABA, offering teachers a protocol to relatively rapidly teach spontaneous requesting and other critical functional communication skills. Although more research is clearly needed, the use of PECS by young children appears to be associated with improvements in communication and speech production and with other positive behavior changes. Although PECS was designed for young children with autism, it has been demonstrated to be effective with other age cohorts and populations. As with the expansion of many popular systems, there have been a number of misunderstandings and misrepresentations associated with the system. I have attempted to deal with many of the issues that have been raised regarding the use of PECS and have tried to point out relevant theoretical and empirical issues to clarify many of these concerns.

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