Turning on "the light for communication"[1]

Intervention using the Picture Exchange Communication System (PECS) for children with autism

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Abstract

An estimated 35% of children with autism never develop useful speech (Gerenser, 2006). There are many interventions that seek to teach non-verbal children language and communication skills; however, for many children with autism, therapies using speech or sign language are not effective because they do not teach the children how to use language. The Picture Exchange Communication System teaches children to make requests by exchanging a pictorial symbol, which provides them with functional communication and the motivation to use it. PECS training also teaches children to be persistent communicators, to discriminate between symbols, to create basic sentences, to respond to questions, and to make comments. While some children who learn PECS eventually develop enough speech to use spoken words in place of PECS, other children continue to use symbol communication. For these children PECS can be extended to teach additional language concepts. Research suggests that PECS is an effective communicative intervention for many children with autism. This paper will examine PECS itself and research conducted to evaluate the PECS system; in doing so, it will investigate what linguistic skills children acquire through PECS intervention, ways in which PECS might be extended, and how research on PECS can be improved.[*]

Introduction

Imagine a hypothetical child, playing with a toy in his preschool classroom. The toy is a box with variously-shaped holes, through which blocks in the shape of squares, circles, and triangles can be pushed. He has the triangle-shaped block in his hand and is trying to push it into

[1] Adapted from a statement by the parent of a PECS user, quoted by Schwartz, Garfinkle, & Bauer (1998, p. 157).

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the square-shaped hole. For obvious reasons, he is having difficulty completing his desired action. He tries pushing harder; when this fails, he begins banging the block against the box. A few seconds later, he begins screaming in frustration. His teacher approaches, but has no idea why he is upset. After a few minutes, she manages to end his tantrum by distracting him with another toy.

This hypothetical boy has autism; like many young children with autism, his communication is extremely limited. Perhaps he has the ability to speak a few words, to make a few signs, to point to what he wants. If he does, he is lucky, because he has a way to express his needs, preferences, and protests to the other people around him. If he does not, screaming may in fact be the best way he knows to get help.

Autism is a neurodevelopmental disorder that is characterized by impairments in social skills, delayed or absent communication, and stereotyped and repetitive behaviors. Its cause is currently unknown. By many estimates, it has been increasing in prevalence over the last few decades, making interventions to improve functional behaviors in affected individuals all the more important. Many individuals with autism have very little useful speech, making communication difficult. Several forms of alternative and augmentative communication (AACs) have been used with this clinical population, with varying degrees of success. One such system is the Picture Exchange Communication System (PECS), which was designed for use with preschool-aged nonverbal children with autism.

This thesis will begin by taking a closer look at what the defining features of autism are, some problems with the current definition, some suspected causes of autism, and what the language of children with autism is like. Next, it will discuss alternative and augmentative communication systems used by individuals with autism and describe the original PECS

protocol, as described by Frost & Brody (1994). In the course of learning PECS, children acquire some knowledge about language, such as how to use words to obtain what they want and how to put words together to produce "sentences"; this knowledge will be discussed in the context of typical language development. For children who do not begin to use speech while learning the six phases of PECS, the system can be extended to teach them more language concepts. Some methods described in the PECS literature will be discussed in addition to other possibilities. Finally, this thesis will examine the research concerning the efficacy of PECS: whether children can learn the system, whether it promotes spontaneous communication, and whether it encourages speech development, among other outcome measures. The validity of this research, as well as how it could be improved by examining why PECS works for some children and which children it tends to work best for, will also be discussed.

Characteristics of autism

Autism was first scientifically described by Leo Kanner in the middle of the twentieth century. The eleven patients Kanner (1943) described in his landmark paper displayed a variety of symptoms, both strengths and deficits, but all of them shared a general social distance: they refused to or were reluctant to engage with other people, and frequently reacted to social approaches by others by either withdrawing or becoming aggressive. They were much more interested in playing with objects than in engaging with other people. Kanner's patients also exhibited a number of other atypical behaviors, though the actual behavioral profiles of the individuals varied. Several of the children had unusually absorptive interests, such as for spinning objects or for pictures of animals. Some of the children tended to perform repetitive and self-stimulatory actions, such as shaking their heads from side to side, humming, or making

unusual motions with their fingers. Strictly following particular rituals was also important to some of the children. In addition, the communicative abilities of the children varied. Some of the children were almost completely nonverbal, making only noises with uncertain meaning; some children spoke words, but without clear communicative intention, repeating what they heard others say; and others could speak clearly and in sentences, but had difficulty carrying on conversations and pronounced their utterances with atypical intonation. The children did demonstrate some strengths, particularly in rote memory; many of them knew large inventories of songs at young ages.

Most of the kinds of symptoms described above have become part of the defining criteria for autism in the Diagnostic and Statistical Manual of mental disorders (American Psychiatric Association, 2000). According to the DSM-IV, "the essential features of Autistic Disorder are the presence of markedly abnormal or impaired development in social interaction and communication and a markedly restricted repertoire of activity and interests" (American Psychiatric Association, 2000, p. 70). A diagnosis of autism requires impairment in three domains: social interaction, communication, and repetitive and stereotyped patterns of behavior, interests, and activities. An individual with autism demonstrates at least two behaviors indicative of impairment in social interaction, such as difficulty making eye contact; recognizing the meaning of particular facials expressions, body postures, and gestures as well as using these with expressive meaning; developing appropriate relationships with peers; sharing objects of interest with others; and sharing emotions with others. To have a diagnosis of autism, an individual must also exhibit at least one behavior indicative of impairment in communication, such as a lack of spoken language (not made up for through gesture or mime), difficulty maintaining conversations, stereotyped use of language, idiosyncratic language, and lack of developmentally

appropriate play. Finally, for a person to be diagnosed as having autism, they must exhibit at least one of the following behaviors: a preoccupation with an interest that is "abnormal either in intensity or focus" (American Psychiatric Association, 2000, p. 75), a dependence on fixed routines, unusual and repetitive patterns of motor behavior such as hand flapping, or an unusually strong interest in the parts of objects. This collection of observable symptoms defines "autism."

Autism, or "Autistic Disorder" as it is referred to in the DSM-IV, is one of five disorders included under the DSM-IV (American Psychiatric Association, 2000) umbrella of pervasive developmental disorders; this series of disorders is sometimes referred to as autism spectrum disorders or ASDs. Pervasive developmental disorders are defined by impairments in the three areas described above for autism – social interaction skills, communication skills, and stereotyped behavior/interests/activities – but the specific characteristics of each disorder are slightly different. The four other ASDs are Rett's Disorder, childhood disintegrative disorder, Asperger's syndrome, and pervasive developmental disorder not otherwise specified or PDD-NOS. Rett's disorder has only been diagnosed in females, and is defined by decreased head circumference, loss of previously acquired skills, and motor impairments in addition to the kinds of impairments found in autism. Childhood disintegrative disorder shares most of its features with autism, but is defined by typical development for two years before regression is observed. Asperger's syndrome is diagnosed when a child has normal language development but exhibits social impairments and restricted/repetitive behaviors. Finally, a diagnosis of PDD-NOS is made when a child exhibits autistic behaviors but not enough of them to meet the criteria for another disorder.

All of the pervasive developmental disorders are defined by a collection of behaviors of which the individual must have a certain number; the result is that the individual presentation of symptoms can be quite different across individuals. This can be problematic for making generalizations within or across the disorders. One person who according to the DSM-IV has "autism" might have difficulty making eye contact, trouble making friends, flat intonation, and an intense fascination with cars, but overall be functioning for the most part independently in his or her daily life; another person with the same official diagnosis could present with an inability to understand emotions in others, a failure to share interests with other people, no functional language, and a fascination with making interesting shapes with his hands rather than focusing on the external world. Although the broad categories of impairment are the same, the manifestations of the disorder are quite different, and have very different implications for the kind and intensity of intervention and support required in the individual's life. Thus, the flexibility built into the DSM-IV diagnostic criteria, while providing a wider scope for the disorder, also introduces a degree of opacity into autism research, because individuals grouped together may not have exactly the same disorder – unlike, for example, two individuals with Down syndrome, who have in common the biological fact of having three copies of chromosome 21 and the concomitant medical conditions.

The precise etiology of autism is unknown; its cause probably has a very complex explanation (Wozniak, 2010a). It is unlikely that autism is caused by one genetic or environmental factor, because no factor has been found that correlates perfectly with the disorder. Family and twin studies (cited in Kinney, Miller, Crowley, Huang, & Gerber, 2008; Rodier & Hyman, 1998) indicate that there is likely a genetic component, because the disorder is more likely to occur in relatives who share more genes, and much more common than in the

general population. However, this cannot be the only answer because the rate of diagnosis in autistic children's siblings is too low (3-9%; Smalley, Asarnow, & Spence, 1988, and Jones & Szatmari, 1988, cited by Rodier & Hyman, 1998). Some kind of environmental factor must also influence the development of autism. Many kinds of environmental factors, including toxins, stress, and infectious disease, have been proposed as the cause of autism, and exposure to some of these has been shown to be related to autism occurrence, though not *how* these factors might cause autism. Another problem is that not everybody exposed to these environmental factors develops autism. Thus, a more likely scenario is that some combination of gene(s) and environmental factor(s) causes autism. A third factor that probably contributes to autism is timing; one study (Kinney et al. 2008) demonstrated that fetuses exposed to environmental stressors during particular periods of gestation were more likely to develop autism later. So developing autism would require that a child have particular gene(s) and be exposed to one or more environmental factors at particular periods of development. Finally, some of the causal factors of autism and autistic behaviors might emanate from the child herself. A child's brain constantly changes based on the sensory input it receives, and if this input is in any way abnormal – resulting from the child behaving abnormally and thus receiving atypical responses from her environment – then development is likely to proceed on a skewed trajectory. A complex, but consistent with evidence, model of autism etiology is: a child inherits a predisposition to autism, which combined with the results of detrimental environmental exposure(s) at particular time(s) causes her to behave atypically, resulting in atypical experiences during development, all of which shape her brain such that she eventually becomes "autistic."

Language in children with autism

Gerenser (2009) describes some of the characteristics of language in children with autism, which are as variable as any of the other behavioral symptoms of autism. Although mental retardation is frequently comorbid with autism, general cognitive deficits do not seem to be the cause of language deficits evident in autism. Language in children with autism is generally delayed when it does develop; in addition, an estimated 35% of children may never develop functional speech, a large minority. Those children that do develop speech usually exhibit intact phonological skills and typical vocabulary levels; however, they usually learn words for objects before those for people and social greetings, and some evidence suggests that they may have an atypically-organized lexicon. Some children have specific deficits in syntax similar to those observed in Specific Language Impairment (SLI). The speech of many children with autism contains echolalia, or "repetition of what has been said by someone else" (Gerenser, 2009, p. 75); for example, if asked if they want "a hamburger or hot dog," the child would answer "hot dog," while when asked if they want "a hot dog or a hamburger," the child would answer "hamburger," because they are simply repeating the last thing that they heard. Another linguistic structure that gives children with autism difficulty is deixis, perhaps because the meanings of deictic expressions change based on the context of the utterance, such as who is speaking and when and where the utterance is spoken. A commonly reported exemplar of deixis in individuals with autism is pronoun reversal; for example, a child requesting that an adult pick him up might say, "I pick you up." Both echolalia and pronoun reversal were among the symptoms described by Kanner (1943) in his patients. A final characteristic set of language deficits in children with autism are pragmatic in nature. As included in the DSM-IV criteria for autism, people with autism have difficulty using gestures, intonation, facial expressions, and eye contact to

understand meaning communicated by others or communicate meaning themselves, so they frequently are unaware of information expressed nonverbally. Furthermore, individuals with autism have marked difficulties in obeying the rules of conversation, such as turn-taking.

A number of interventions have been created for the various language and communication deficits characteristic of children with autism. Some of those designed for the significant minority of children who are non-verbal or have no functional communication are discussed below.

Language and communication interventions for non-verbal children with autism

Howlin (2006) provides an overview of communicative intentions used for children with autism. As stated above, many children with autism do not develop spoken language, and the speech of some children consists mostly of echolalic, stereotyped, or irrelevant phrases. Since these children have difficulty with communication in general, in addition to any particular linguistic form, it is essential that any communicative intervention enhance their communicative skills and desire to communicate in addition to providing a means by which to communicate. Early studies attempted to use operant conditioning to teach speech to children with autism, but this method produced little progress after a large number of trials. The next generation of communicative intervention tried sign language as a medium for communication. Sign language was thought to be the language solution for individuals with autism because (1) it did not require communication via speech, which was thought to be a specific problem for children with autism; (2) the visual input from sign language is available to the senses longer than the auditory input from speech, allowing the individual more time for processing; and (3) it was easier to prompt sign production (by molding the individual's hands into the desired signs) than to prompt spoken

sounds. At first, conventional sign languages, including American Sign Language (ASL) and British Sign Language (BSL) were used in intervention; however, these were found to be too complex and abstract for many individuals with autism to learn. As a result, some simpler signing systems were developed. Few well-conducted studies of sign language acquisition in individuals with autism occurred, and the progress in those that were conducted was determined by the number of signs acquired rather than the acquisition of pragmatic skills. While sign language might be effective for some children with autism, it is also not an ideal system - children with autism have difficulty with the fine-motor, linear sequencing, and imitation skills required for successful sign-language acquisition.

An alternative to teaching formal languages to children with autism is to use an alternative and augmentative communication (AAC) system. Interventions using AAC have a broader focus, teaching children social and communication skills in addition to communicative symbols. AAC interventions define communication as:

> Any act by which one person gives to or receives from another person information about that person's needs, desires, perceptions, knowledge, or affective states. Communication may be intentional or unintentional, may involve conventional or unconventional signals, may take linguistic or nonlinguistic forms, and may occur through spoken or other modes. (National Joint Committee; quoted in Beukelman & Mirenda, 1998, p. 3)

The American Speech-Language-Hearing Association defines AAC as:

> An area of clinical practice that attempts to compensate (either temporarily or permanently) for the impairment and disability patterns of individuals with severe expressive communication disorders (i.e., the severely speech-language and writing impaired). (ASHA; quoted in Beukelman & Mirenda, 1998, p.3)

Lloyd, Fuller, & Arvidson (1997) described how AAC mimics the typical human communication. According to the basic human communication model, there is a sender and receiver of communicative messages. The act of communication itself involves the transmission of a message from the sender to the receiver, who might or might not respond. Because the

process is usually interactive, the communication roles then reverse and the receiver becomes the sender. Likewise, AAC has a sender with a communicative intent who sends a message to a receiver who is engaged with the sender, symbols that represent messages, a channel through which the message is sent (a sensory modality such as vision, hearing, or touch), the context in which the communication takes places, and feedback systems between sender and receiver. The goal of AAC is to develop competent communicators, regardless of the manner of communication.

Lloyd et al. (1997) also provide a number of reasons why AACs using symbols might work when speech therapy does not. First, the communicative input that the child receives is simpler, because the clinician typically speaks while using the individual's symbol system. Since the speech input parallels the symbol input, the symbol input slows the rate of speech down; it also aids receptive language, because the symbols highlight important semantic concepts in the spoken utterance. In addition, AAC provides a manner of responding that is easier for many individuals, because it eliminates the social pressure to use speech and is less motorically demanding; it is also easier to teach because it is possible for the clinician to physically prompt the AAC user. For many individuals, it is easier to process the symbols used in AAC than speech: visual symbols are more easily differentiated from the other objects in the child's visual field than spoken words are from background noise; the presentation of symbols is more consistent than that of spoken words (i.e., a symbol always appears the same, but a spoken word can vary in its volume, pitch, intonation, voice quality, and other characteristics); symbols are available for a longer period of time than spoken words; the symbol and the referent are frequently in the same modality (i.e., both visual); and symbols are usually more iconic than spoken words.

However, symbol communication systems are not perfect. As Howlin (2006) describes, they are generally slow and have limited productivity (meaning that the ideas that can be expressed using these systems are somewhat limited). But since they make less of a demand on cognitive skills and memory capacity, and do not require a high degree of fine-motor control, a number of symbol systems have been developed, including Rebus and Bliss symbols. One of the better-known AAC symbol systems is the Picture Exchange Communication System (PECS).

The Picture Exchange Communication System

PECS (Frost & Brody, 1994) was developed as an AAC specifically for preschool-aged children with autism and related socio-communicative disorders – children who have minimal or no ability or desire to communicate.[2] The authors of the system suggest that their system has several advantages over other communicative interventions for young children with autism. Speech training is very slow and leaves children no way to communicate in the interval until they can speak some words, if they acquire the ability at all. AACs using speech or sign also require children to have the ability to share a point of focus with an adult and to imitate actions that they see the adult do, both behaviors that children with autism have difficulty with. Finally, the authors state that typically developing children learn language in part because of the associated social rewards for doing so. Their social deficits mean that children with autism are generally not sensitive to such social rewards. Thus, they have little incentive to learn language. The protocol used in PECS provides material rewards for communication in the context of the communicative exchange, giving children with autism better reason to learn to communicate without artificial reinforcement.

[2] References to the "PECS protocol" throughout this paper indicate the instructions for teaching the six original phases of PECS as described in Frost & Bondy (1994)

As described by Frost & Brody (1994), PECS is a low-tech AAC because it does not require any electronic devices; rather, the system uses laminated line drawings and a step-by-step protocol. The system has six phases that require one to two adult "trainers," various numbers of pictures, supports upon which to Velcro the pictures, and the reinforcers themselves, such as favorite foods and toys. In the first phase, "The Physical Exchange," the student learns to pick up a picture, put it into the hand of a trainer, and release the picture upon seeing that the trainer has an item that the student wants. At this stage only one picture at a time – the one corresponding to the item that the trainer has – is used, in order to simplify the task until the student can complete the necessary motions. Initially the second trainer uses physical prompts (guiding and molding the student's hand as necessary) to help the student complete the transaction. As the student learns the motions required for the exchange, the trainer helps less and less until the student can perform independently and successfully on eighty percent of trials. The second phase, "Expanding Spontaneity," requires the student to exercise more initiative in obtaining the desired item; whereas previously both the student and trainer were seated at a table, now the student is required to go to her communication board, remove the picture, go to the adult located somewhere else in the room, and deposit the picture into the adult's hand in order to obtain the desired item. The third phase of PECS, "Picture Discrimination," requires the child to recognize that the different pictures represent different objects in the real world. The training in this phase begins with just two pictures, one of a desired item and one of a non-preferred item. The student is given the item which he requests, which if they are not discriminating between the pictures might not be the one he wants. If the child has a great deal of difficulty with choosing the correct picture, extra steps helping to teach the child to discriminate may be introduced, such as using blank cards as distracters. If, however, the student is capable of discriminating between pictures

and using the appropriate picture to request the desired item, then the number of pictures available to the student is increased to make discrimination more challenging.

At this point in the PECS protocol, more abstract symbols and symbol combinations are introduced. In Phase IV, "Sentence Structure," the student is taught to combine the symbol for a desired item with a symbol representing "I want" (see Figure 1).[3] At this stage, the student's tools include a communication board on which pictures are kept, a Velcro sentence strip on which to combine symbols, and typically between twenty and fifty symbols. At first the symbol for "I want" is attached to the sentence strip prior to the child approaching it; the child's task is to place the symbol for the desired item to the right of "I want" and take the sentence strip to the communicative partner who has the desired item. Once the student masters the task at this level, the student is physically prompted to remove the "I want" symbol from the communication board and place it and the symbol for the desired item on the sentence strip. Mastery of this phase occurs when the student can successfully add the symbols for both "I want" and the desired item to the sentence strip and exchange the sentence strip with a communicative partner without any prompts on 80% of trials.

Figure 1. An example of a Phase IV PECS utterance, [I WANT] + [PRETZEL], on a sentence strip.

Phase V of Frost & Brody's (1994) PECS protocol, "Responding to 'What do you want?'", introduces an additional language skill, responding to questions. This skill is taught by having a desired object available and the "I want" symbol on the communication board. The

[3] The pictures of PECS symbols in this paper were all taken by the author. The symbols were created using images from Boardmaker Plus! software (Mayer-Johnson Co., 2009).

teacher begins by simultaneously pointing to the "I want" card and asking, "What do you want?" The student should subsequently perform the regular exchange by putting the symbols together on the sentence strip and giving it to the teacher in exchange for the desired object. After the student is successfully able to perform the exchange in this scenario, the length of time between the teacher asking "What do you want?" and pointing to the "I want" symbol on the communication board is lengthened. It is recommended to increase the time interval by about one second at a time. Eventually the student should understand what the acceptable response to the question is and complete the exchange before the teacher prompts them by pointing to the "I want" symbol on the communication board. By the end of this phase, the student should be able to both make spontaneous requests and respond to "What do you want?" using their symbols and without any external prompting.

Finally, in Phase VI of the PECS protocol (Frost & Brody, 1994), "Responsive and Spontaneous Commenting," the student is taught more question/statement pairs similar to "What do you want?"/"I want". Here, however, the focus is not on requesting but rather on expanding the skills that the student learned via requesting and applying them to commenting. The first new abstract symbol to be introduced is "I see." This is placed on the communication board under "I want"; several symbols that the student has already learned, but which do not represent highly desirable items, are also placed on the board. The teacher

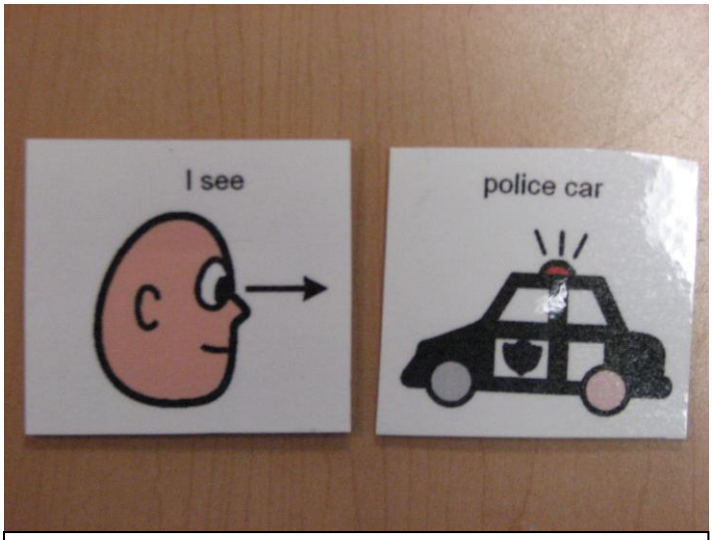

Figure 2. An example of a response that a child could make using an [I SEE] symbol.

holds up one of the less preferred items (the symbol for which is on the board) and asks the student, “What do you see?” Training then proceeds as it did with “What do you want?” – with the teacher at first physically prompting the student to complete the exchange, as necessary, then introducing a delay to provide the time for the student to complete the exchange unprompted. When the student completes the exchange correctly, the trainer, according to PECS protocol, comments, “Yes, you see a _____,” and rewards the student with some reinforcement unrelated to the object. Using familiar but less-preferred items as the object of comment at this point is helpful because until the student learns the difference between requesting and commenting, they will be expecting to receive the object as a result of completing a communicative exchange. If the object is not highly desirable, the student’s reaction to not receiving the item will not be as negative as it would be for a highly desirable object. In addition to some small material reward, the student should also receive social praise from the teacher. Once the student can successfully comment on less-preferred items, the object of comment is extended to highly preferred items and non-preferred items. Before training continues, the student should also be able to perform these exchanges with at least two different teachers.

The next step of Phase VI (Frost & Brody, 1994) involves the teacher mixing the two questions that have been learned. If the student cannot discriminate between the two questions, then delayed prompting is continued until the student is able to correctly answer the two questions. By this stage the student is also able to request items that are not in their immediate view, so “seeing” and “wanting” are not necessarily co-occurring. Once the student can discriminate between the two questions, a third, “What do you have?”, is introduced. “What do you have?” is taught in the same manner as “What do you see?”, and is at first isolated from the other questions. Once the student masters the new question, the three questions are mixed until

the student can appropriately answer all three of them when introduced randomly. The PECS protocol recommends introducing further questions at this stage, such as “What is it?” and “What do you hear?”, using the same technique as for the other questions. The final step of Phase VI involves teaching the student to make spontaneous comments. To do so, the teacher gradually reduces their use of explicit verbal prompts (such as “What is it?”) and begins to use more subtle cues such as gestures or at least minimal verbal cues (such as “Look!”). If the child does not respond well to the new cues, their response via the exchange can be prompted until they perform the exchange on their own. Strategies such as using games that introduce objects as a surprise or looking at a picture book are recommended for creating opportunities to comment. Ideally, the student will learn to comment on environmental stimuli without any sort of prompt from the people around them and thus will be truly spontaneously communicating.

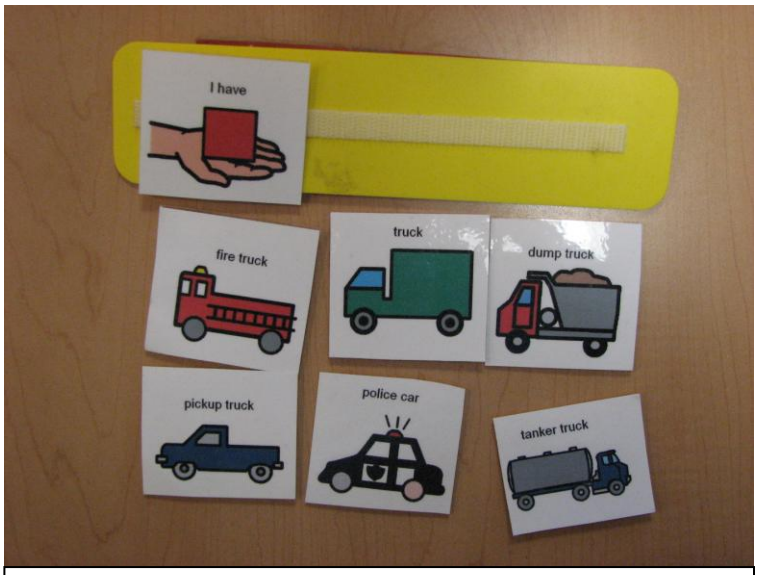

Figure 3. A hypothetical child using these materials during an activity involving play with toy vehicles could respond to the question “What do you have?” by selecting the correct symbol from an array of symbols related to that activity.

The phases described above are the six phases of the explicit PECS protocol as described by Frost & Brody (1994). Other steps are recommended in the PECS manual for expanding the student’s language skills via their pictorial communication system. These include colors, sizes, and locations, and answering yes/no questions.

Linguistic aspects of PECS

Communication between two people can be performed using any system of mutually recognized symbols. This set of systems does not necessarily comprise a "language," however. Hockett (1960) described a series of "design features" of language designed to discriminate human language systems from animal communication systems and other communication systems devised by humans. While not all of these design features are still relevant to discussions of language – for example, one of the design features is use of the vocal-auditory channel, which with the recognition of sign languages as languages is no longer correct – they are still useful in considering what makes a language and what makes a communication system.

Some of the design features are shared by both PECS and by natural human languages, such as semanticity and displacement. Semanticity means that the words are symbols and have meaning; both words and PECS symbols represent some referent. Likewise, both natural language and PECS have the ability to refer to items, people, or actions that are not immediately in view. Just as someone while speaking can ask for a hot dog at snack time (though it is not in sight, not habitually in that environment, and unlikely to be available), a child using PECS could exchange their sentence strip asking for a hot dog at snack time (though this option should probably not be made available during training as the child is likely to be disappointed).

Some of the design features – arbitrariness and productivity – are shared to a limited extent. Words, with few exceptions, are totally arbitrary, meaning that there is no inherent relationship between the form or appearance of the symbol and the form or appearance of the referent. PECS symbols are less arbitrary, though of course this depends on the pictures selected for use on the symbols. Some PECS symbols are thoroughly iconic, meaning that they look like what they represent; for example, the [PRETZEL] symbol most likely displays a picture of a

pretzel in most PECS users' communication books. Also, natural languages are endlessly productive, meaning that their components can be combined and recombined to form an infinite number of novel utterances. While multi-symbol PECS utterances are in theory productive, because new symbols can be introduced into the lexicon and because the symbols can be recombined to some degree, the productivity is severely limited by the very few ways in which PECS symbols can be meaningfully combined.

Finally, a few of the design features crucially distinguish PECS from natural languages; these are interchangeability and duality of patterning. Both interlocutors in a communicative exchange using natural language employ speech or sign to express their ideas. In contrast, PECS is essentially just a system for the expressive language of the child. The adult responds in speech; thus the system is not interchangeable in practice, though perhaps in theory it could be. Duality of patterning means that a limited number of meaningless components, such as phonemes, can be combined to create meaningful symbols. While this is how words are created in natural language, this feature largely is not used in PECS. While some symbols might use common elements in a somewhat systematic way – for example, the difference between the example symbols for [BIG] and [LITTE] is the displacement of an arrow (see Figure 4) – this strategy is not consistently used throughout the symbol system. The pictures used for symbols are essentially infinite in number.

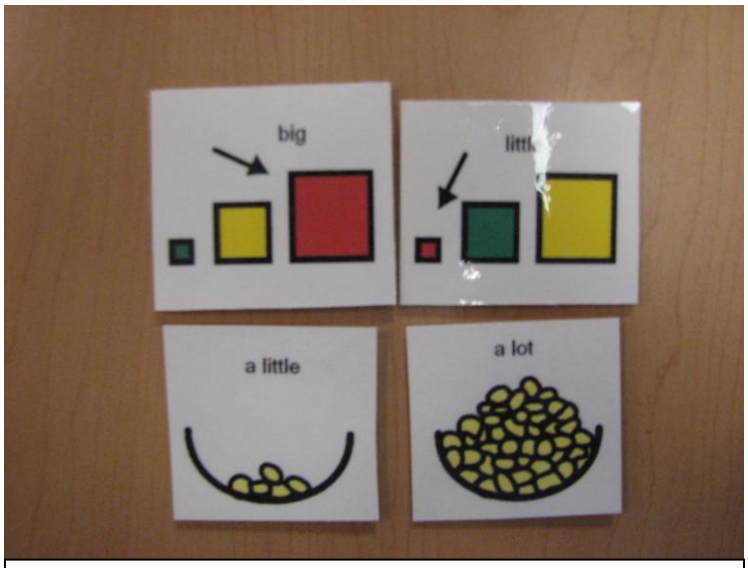

Figure 4. The symbols for [BIG] and [LITTLE] share some common elements.

As demonstrated via the design features, PECS is a system for communication rather than an actual language, but it does share a foundation with formal language: the messages that are communicated via PECS are between two communicators and exist in a certain code. This code can be analyzed in terms of its vocabulary and semantics, form, syntax, morphology and pragmatics.

Vocabulary/Semantics

The vocabulary of PECS is its symbols and the ideas they represent, just as the vocabulary of a spoken language consists of its words and the ideas they represent. The size of this vocabulary varies among children, what stage of PECS training they are in, and their communicative needs. For instance, during Phase I, when the child is being taught to request highly desirable items, he will have a small vocabulary limited to the highly desirable items targeted for use in training. As the child progresses in the PECS training, this vocabulary will expand to include less desirable items and non-preferred items, verbs, and other words. The number of symbols acquired by any particular child will vary based on the child's interests, the number of environments in which the symbols are used, and the ease with which the child can acquire the symbols. One child, described as typical in his acquisition of PECS, acquired

Figure 5. PECS vocabulary can be expanded depending on the symbols needed by the child. This set of symbols would be useful around Thanksgiving.

approximately 100 symbols in 13 months before he began to use speech rather than symbols. Other children may not learn as many symbols if acquiring new symbols is difficult for them.

The semantic meanings of PECS symbols seem relatively straightforward to the trainer who already knows a language. A picture of a pretzel or cookie means, to the trainer, "pretzel" and "cookie" respectively, while the symbol for "I want" corresponds to the sender of the message and their current state. However, as far as I know there has not been any research done into what the PECS symbols mean to the child who is being taught to use them. It seems logical that the extent to which the child's understanding of the meaning of the PECS symbols corresponds to the trainer's understanding of their meanings would depend to some extent on the child's receptive language abilities. According to the PECS protocol, the trainer interacts with the child in spoken words, so the child's ability to understand what the trainer is saying should influence what they think the symbol means. If the child has very poor receptive language, then their experience of figuring out the meaning of a symbol is much like the linguist in Quine's problem of reference; he or she has no way of knowing exactly what the symbol means out of the many possibilities offered by the context (Quine, 1960, cited by Woodward, 2000). To Quine's linguist in the jungle, the word *gavagai*, uttered when a rabbit is in view, might mean rabbit – however, it might also mean something like "Look at that!" or refer to some part or attribute of the rabbit, rather than the rabbit as a whole. Similarly, imagine a communicative context in which a child exchanges a symbol containing a picture of a cookie with their teacher in order to obtain a cookie. It is possible that the child will interpret the symbol as having the same meaning as the teacher – that is, that the symbol is a representation of the physical object of the cookie, which he wants. However, it is possible that the child might also think that the symbol is a representation of the action of eating a cookie, which he also wants and which will be brought

about by the communicative exchange. A third possibility is that the cookie symbol could represent the action of receiving a cookie, which he wants because this will allow him to eat it and which will also be brought about by the communicative exchange. A fourth, though less likely, representation could be that the symbol of the cookie represents the internal state of desiring a cookie, which the child is expressing to his teacher so that she will give him one. This fourth representation is the least likely because many children with autism do not have the self-reflective abilities required to consciously acknowledge such an internal desiring state and intentionally express it to another with the anticipation of receiving the object of their desire. Although the multiple possibilities of referents for such an obvious symbol as a cookie may seem far-fetched to someone who has already acquired a language, it is not unheard-of for children with autism to develop atypical associations between communicative symbols and their referents. Two such examples can be found in Kanner's (1943) first description of autism.

> The word "yes" for a long time meant that he wanted his father to put him up on his shoulder. This had a definite origin. His father, trying to teach him to say "yes" and "no," once asked him, "Do you want me to put you on my shoulder?"
>
> Don expressed his agreement by repeating the question literally, echolalia-like. His father said, "If you want me to, say 'Yes'; if you don't want me to, say 'No.'"
>
> Don said "yes" when asked. But thereafter "yes" came to mean that he desired to be put up on his father's shoulder. (p. 220)

> At the sight of a saucepan he would invariably exclaim, "Peten-eater." The mother remembered that this particular association had begun when he was 2 years old and she happened to drop a saucepan while reciting to him the nursery rhyme about "Peter, Peter, pumpkin eater." (p. 227)

Thus, it is important to not assume that a child with autism who is learning any symbol-based device is acquiring the same symbol-referent pairings that seem obvious to those who have already acquired a language. Some incorrect symbol-referent pairings might be corrected with experience on the part of their child; the child might also be aided in ultimately deriving the correct meanings for symbols by later phases in the PECS training protocol, in which the single

symbol for an object is paired with other symbols. The ambiguity of reference is created for the child as a result of learning the symbol in a communicative context, rather than being taught, one by one, the labels for objects without using the labels for any communicative function. However, although it creates such a situation of ambiguity, teaching the symbols in a communicative context fosters communication in general because it teaches the child that the labels are not just interesting sounds or pictures; they can be used for a purpose.

Another aspect of the semantics of PECS symbols that should considered is the scope of their meaning. Young typically-developing children sometimes overextend or underextend the meanings of words – for example, calling a goat a dog. Typically-developing children receive feedback on their mistakes and eventually narrow down or broaden the meanings for lexical items to the appropriate level. Thus, we should not be surprised if children learning PECS also had issues with the appropriate extension of the meanings of their symbols. The meaning that a child associates with a particular symbol might depend to some extent on the experience she has with it. For example, if a child only ever exchanges a [COOKIE] symbol for Oreos, she might not generalize that a chocolate chip cookie can be represented by [COOKIE] also. For that particular child, [COOKIE] essentially means "Oreo". Not recognizing the potential issue of extension of such a symbol might lead to a communicative breakdown if, for example, a child exchanges [COOKIE] with a teacher who does not know that she likes Oreos and instead gives her chocolate chip cookies. To the teacher, "cookie" has a number of exemplars; for the child, [COOKIE] has only one exemplar, that of an Oreo. *Cookie*, *Oreo*, and *food* are also examples of the various levels of semantic categorization. In this case, *cookie* is the ordinate level, *Oreo* is the subordinate level, and *food* is the superordinate level. To a fluent language speaker, any of those three labels could technically be applied to an Oreo; which one he used would depend on how

specific he wanted his utterance to be. The amount of PECS vocabulary a child has will influence the degree of specificity that she can obtain; a lack of appropriate vocabulary in an area in which a child may wish to be very specific – for example, asking for a particular toy truck out of a collection of toy trucks – may stymie effective communication. On the other hand, depending on the cognitive abilities of the child, having too much vocabulary, particularly for the same item, may be confusing. If a child is only capable of associating one meaning with each symbol, then having both [COOKIE] and [OREO] in the child's symbol lexicon is inappropriate and will only confuse them, especially if there are other potential referents for [COOKIE] in the communicative context. Thus, trainers and teachers must carefully consider such semantic issues when selecting a child's symbol lexicon and teaching it to him when implementing PECS.

Initially, in Phases I and II, the child's symbol lexicon will probably consist almost exclusively of perhaps three semantic groups: preferred food, preferred toys, and preferred activities. Although the communicative exchange process may seem most conducive to using objects as reinforcers, if particular activities are particularly strongly reinforcing then it will be useful to include them in the lexicon. For example, people with autism characteristically have unusual interests that absorb them to an unusually great extent, which in many situations might interfere with attempts to communicate. In PECS, these interests, no matter how unusual, can be manipulated

Figure 6. Many of a child's PECS symbols might represent food items if these foods are highly reinforcing.

to create communicative opportunities. If a child has a particular fondness for playing with pieces of string, he can be taught to exchange a symbol for string in order to obtain a string to play with. An instance such as this could contribute to the confusion described above regarding the actual referents of symbols, since in such a situation the child's goal is not just to obtain the string but to play with it. Thus, whether the symbol actually represents the string or the activity of playing with string is unclear. Although in the string example a symbol for string might be used to represent both the string and the activity, in other instances symbols might more clearly reference just an activity – for example, going outside, jumping, or running. While the PECS protocol is very specific about how symbols are taught, it leaves the determination of the symbols themselves open-ended. This gives the trainer the flexibility to choose symbols that are both relevant to the child's interests and daily activities and also allows for the actual symbol chosen to be the one that will most clearly represent the referent that the trainer intends.

Form of the symbols

The PECS protocol does not specify what pictures in particular should be used in communication training; rather, the protocol focuses on how to use the symbols in teaching children how to participate in communicative interactions. Any pictures can be used – black-and-white line drawings, cartoons, photographs, or product logos could all potentially be used in an exchange. One frequently-used set of pictures is the Picture Communication Symbols, which are obtained via commercially available software (Mayer-Johnson Co., 2009). Regardless of what the pictures are, the PECS protocol (Brody & Frost, 1994) recommends laminating the pictures and using a hook-and-loop system (i.e., Velcro) so that the pictures can be stuck to the communication board/book and sentence strip.

Figure 7. Although line drawings from Boardmaker are frequently used in PECS training, photographs can also be used and might be more appropriate for requesting specific types of items like toys that are available in the training environment.

Although I have not read any research, if there is any, about the relative effects of using different types of pictures, it seems reasonable that pictures with different degrees of detail might influence the child's interpretation of the symbol's meaning. For example, a picture that is a drawing of a generalized cookie might be used for all kinds of cookies – or, at least all kinds of cookies of a particular type, such as chocolate chip cookies. However, if the child typically eats Chips Ahoy chocolate chip cookies, and the decision is made to use part of a Chips Ahoy product label as the symbol for these cookies, then the child may not generalize this symbol to other brands of chocolate chip cookies. On the other hand, a child might not be able to understand the communication of the general concept of a cookie, particularly when the child has a particular kind and brand of cookie in mind, so using such specific symbols as product labels might allow for more exact and expedient communication.

Syntax

The syntax of the utterances that a child can create is somewhat limited and defined by the phase of PECS that the child is being trained in. In Phases I through III, the child is only capable of making one-symbol utterances. This may seem incredibly limited, but in the earliest

phases of language development even typically-developing children (although much younger than most of the children who learn PECS) begin by making one-word utterances, so in this way the ontogeny is somewhat similar. A typically-developing child will use one-word utterances to mean much more than the actual meaning of that one word. For example, a child may say the word "cat" to request a stuffed cat toy from her mother or to point out the neighbor's cat to her mother when they are out for a walk. Likewise, a child with autism can use a symbol to mean much more, for example, exchanging a symbol for a trampoline in order to be allowed to jump on a trampoline (a child using PECS will initially only make requests).

After Phase IV of PECS, a child is capable of expressing two-symbol utterances through his symbol system. These two-symbol utterances have a very predictable structure because they are drawn from three syntactic categories of symbols that are combined in a standard order. The first class of symbols contains content symbols, consisting of symbols representing objects, such as foods and toys, and activities. The second class of symbols contains function symbols which determine the kind of speech act the child is performing. For example, during Phase IV the child is trained to make two-symbol requests using the [I WANT] symbol, a functional symbol, with a desired object or activity from the content symbol class. Although the child may put these symbols on the sentence strip in no particular order, Frost & Bondy (1994) recommend training the child to use the order [I WANT] + _____, and recommend color coding the symbols and sentence strip if necessary.

Morphology

In the six-phase PECS protocol, the morphology is very straightforward: each symbol is an intact whole with no component parts. There might be some incidental similarity between semantically-related symbols; for example, the symbols for [THANKSGIVING] and [TURKEY] provided in the Boardmaker software frequently used to create PECS symbols both contain line drawings of turkeys. The similarities between semantically-related symbols are not, however, systematically exploited to make the symbols productive.

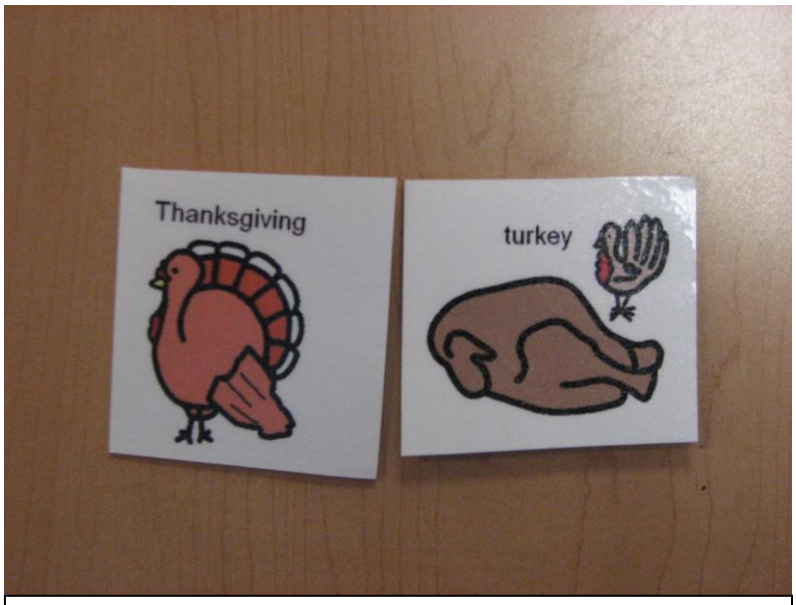

Figure 8. These symbols share a picture of a turkey, suggesting that they are semantically related.

If picture-symbol communication is used to teach the child more advanced linguistic concepts, such as those described above, then in theory affixes could be used for such purposes as pluralizing nouns. Given that the number word expresses that the child wants more than one of the item, pluralizing the content word is redundant. As with other points made about supplementing the first six phases of the PECS protocol, decisions on whether to include such a dimension in the child's training depends on the ultimate communication goals for the child.

Pragmatics

Because of the social deficits inherent in autism, it is important that there be an emphasis on pragmatics in any communicative intervention (Beukelman & Mirenda, 1998): even for individuals who do acquire advanced linguistic skills, "morphology plus syntax plus semantics does not equal communication" (Rees 1982, quoted by Beukelman & Mirenda, 1998, p.257). Many intervention approaches using AAC begin to teach symbol systems without ensuring that the individual can use or even understand basic skills of communication, such as turn taking, joint attention[4], and that other people play a role in communication as communicative partners. (Beukelman & Mirenda, 1998). Since many children with autism lack such skills, simply teaching them words and phrases can result in a child who can only produce words and phrases – that is, cannot use them productively in any sort of social interaction. As an anecdotal example, some children with autism whom I have worked with seem to understand that using particular words produces particular outcomes in their environment – for example, that saying "chips" will cause chips to appear on their napkin at snack time – but do not appear to understand that it is necessary for another human being to hear and understand those words for the outcome to be produced. "Chips" is being thrown out to their environment, and since people are usually in close proximity and attending to them, the outcome is produced; however, they fail to engage the human who produces that outcome in any way.

PECS does not require any prelinguistic skills (such as engaging a communicative partner) to be in place before beginning intervention with a child. However, it does teach its basic linguistic skills in an interactive context. That is to say, the child is not being taught "this symbol means chips" and then, perhaps later, being instructed in the chips-symbol's use in

[4] Joint attention is when two individuals share a common focus of attention, such as an object or event. This aspect of communication will be discussed in more detail later in the paper.

communication; rather, the fact that "this symbol means chips" is at first secondary to the fact that exchanging it with a person produces a desirable outcome. In Phase I, all that the child is being taught to do is to exchange one thing for another thing. The child may not initially even notice that the symbols they are exchanging are different for each kind of object they exchange for (which is why Phase III emphasizes on discrimination). But the regularity of the exchange – Frost & Brody (1994) emphasize that when a child makes an exchange, the anticipated outcome *must* occur in order to reinforce the association between the act of exchange and the outcome – teaches the child that they can effect a change in their environment through another person. Beukelman & Mirenda (1998), in their discussion of communicative intervention for pre-symbolic communicators, emphasize that interveners should respond to an individual's spontaneous behaviors not intended to be communicative as if they were communicative, because it will teach the individual to eventually use those behaviors intentionally. Likewise, Olsson & Granlund (2003) state that for a child who is functioning at a presymbolic level to learn that their behaviors express a meaning, their communicative partner needs to learn to behave as if all interactions are conveying a message – even if meanings need to be assigned to the child's behaviors because there is no conventional meaning for them. Because children with autism may not produce many spontaneous behaviors toward another person, PECS structures the interaction such that the child is physically prompted to perform a behavior that can be perceived as communicative, even though the child does not intend anything by participating in the exchange. Thus, when one trainer guides the child's hand to exchange a [COOKIE] symbol, an artificially "spontaneous" behavior is produced that the second trainer can respond to. The second trainer gives the cookie to the child as if she had intended to ask for it. When this happens repeatedly, the child learns that the act of exchanging the [COOKIE] symbol with another person

can produce a desirable result by mere association, without any social intuition, and that it has the particular meaning of causing the adult to give her a cookie. Thus, the child acquires a rudimentary understanding of the meaning of behaviors and of using them intentionally to obtain something, all without having to look the trainer in the eye or use vocalizations.

During Phase II of PECS, the assistance of the additional trainer (who is not the communicative partner) is faded and the demands of completing the exchange are increased. Now, the child is being taught that in order to obtain the desired result of the exchange, he must initiate a behavior, rather than waiting for someone to do it for him. The more strenuous demands of Phase II also eliminate the possibility that the child's successful exchanges occur by chance; while the child might just happen to pick up a symbol when it is near him, and just happen to drop the symbol into the adult's hand when it is open in front of him, these chances are virtually nil when the child must walk across the room to retrieve the symbol and walk across the room again to give it to the trainer. In addition, in order to successfully complete an exchange, the child must in some way obtain the attention of the adult with whom she wants to make an exchange. For example, dropping the symbol in front of the adult will not result in cookies in the way that calling out the verbal word "chips!" at snack time might result in chips. The child may not use typical behaviors for getting another person's attention, such as calling his name; she only has to get the adult to open his hand. However, while this approach might not result in *typical* behaviors for attention-getting, it should result in *functional* behaviors for attention-getting, which is all that is fundamentally required to create the conditions for a communicative exchange. The flexibility in attention-getting accommodates children with autism well, because they typically do not initiate or maintain eye gaze. Trying to induce the child to produce socially normative behaviors can be attempted later in intervention if initial approaches are successful,

but teaching the child basic concepts of communication must occur first, regardless of the unconventionality of their form.

Phase III of PECS teaches children to discriminate the symbols. Not only does this teach them that particular symbols have different meanings – i.e., that [COOKIE] means *cookie* and that [PRETZEL] means *pretzel* – but it also teaches them that specific behaviors have different meanings. That is, the outcome of exchanging [COOKIE] with an adult is different than the outcome of exchanging [PRETZEL] with an adult. Before this, the child may have not been cognizant that particular variations in the behavior of the communicative exchange determined its outcome; her understanding of the exchange may simply have been that exchanging a little laminated piece of paper resulted in her getting something that she liked. Teaching children that particular behaviors transmit different messages and thus have different outcomes is the next step after teaching them that their behavior has outcomes, and is a fundamental step on the road to productive symbolic communication.

Summary

In the course of undergoing training in the six-phase basic PECS protocol, a child with autism learns a number of skills that can be applied to long-term communication with visual symbols or used as a foundation on which to develop spoken language. The child learns that her behavior has meaning, and that the meaning of her behavior can be used in order to bring about a desirable outcome in her world. She also learns a set of symbols that represent objects, activities, and functions, and that these symbols can be used as the content of a communicative message. She learns (to a limited extent) that these symbols need to be in a particular order in order to bring about the desired outcome. While this is a limited skill set, it is a valuable introduction to the

world of social communication. In theory, PECS should greatly benefit children with autism who are nonverbal and have limited basic communication skills. However, the effectiveness of the intervention for this population needs to be conclusively established through clinical research.

Comparison of skills acquired through PECS to typically developing language

The vocabularies acquired by children using PECS are somewhat limited. Some of this limitation may be due to cognitive impairments in the child, but it seems likely that some of the limitation is also attributable to the fact that the child has no say in what symbols he acquires; he can only learn what the adults make available to him by creating the symbols. Typically-developing children have an average expressive vocabulary of 10 words at 15 months of age and 100 words at 18 months of age (Tager-Flusberg, Paul, & Lord, 2005). The "typical" child described by Bondy & Frost (1994) had acquired about 100 symbols after about a year of using PECS.

The development of syntax is somewhat similar between typically-developing children and children learning to communicate via PECS. Typically-developing children begin to express themselves using holophrases, in which a single word is used to communicate the meaning of an entire utterance (Tager-Flusberg et al., 2005). This is similar to the utterances expressed through the exchanges made in PECS Phases I through III. A typically-developing child using speech might request a cookie by saying *Cookie!*; likewise, a child in Phases I, II, or III of PECS can request a cookie by exchanging the [COOKIE] symbol. Typically-developing children begin to combine words between 14 and 24 months of age; this speech is generally telegraphic in the sense that it consists almost exclusively of content words (Tager-Flusberg et al., 2005). This stage of language development also closely parallels the communication development that occurs

during PECS training – beginning in Phase IV, the child is required to put two symbols together in order to make a request. The child learning PECS remains in a two-word stage of syntactic development throughout the remainder of the standard protocol. If concepts such as adjectives and locations are taught, then the child will acquire the ability to put three symbols together.

Typically-developing children express a number of concepts through their telegraphic speech: "Children talk about objects by naming them and by discussing their locations or attributes, who owns them, and who is doing things to them. They also talk about other people, their actions, their locations, their own actions on objects, and so forth" (Tager-Flusberg et al., 2005, p. 337). Thus, typically-developing children talk about a much wider range of concepts than children learning PECS can express. The concepts included in the PECS protocol are limited to expressions such as *I want*, *I see*, and *I have*. Unless other linguistic concepts such as possession and verbs are taught, the child will not be able to comment on the world around them in the same manner that typically-developing children do. Again, part of the limitation is inherent in the system and the fact that adults who are not inside the child's head control the vocabulary, and thus the concepts, that the child has access to; however, children with autism are generally not as interested in either the actions of other people or in expressing those actions to a third party, so it is debatable whether such concepts would be expressed by the children even if they had linguistic access to them.

Finally, children being trained according to the PECS protocol have the ability to use only two communicative functions: requesting (e.g., [I WANT] + [COOKIE]) and commenting (e.g., [I SEE] + [DOG]). These communicative functions are also found in the communicative behavior of typically-developing children, though they appear at a very young age, before the child develops speech. Also, very young typically-developing children frequently express other

communicative functions in addition to requesting and commenting, such as rejecting and calling attention to objects (Tager-Flusberg et al., 2005). Thus, children learning PECS, unless they begin to spontaneously use the symbols in a manner indicating a communicative function that is not explicitly taught, are also much more limited in the kinds of functions for which they can use their communication system.

Overall, PECS does not teach children with autism particularly advanced language – many of the skills taught are comparable to those described by Tager-Flusberg et al. (2005) as being typical of children between 18 to 24 months of age or even younger. However, as stated above, this is a distinctly more advanced form of communication than screaming and crying until needs and desires are met, which is one of the few options available to pre-communicative children with autism.

Outcomes and extensions with PECS

Bondy & Frost (2002) state that the purpose of PECS is to provide children with a way to express basic communicative messages to others. Subsequent to completing training in the six phases of the PECS protocol, there are two basic outcomes that can be expected: either the child begins to develop language or she does not. In the training manual, Frost & Brody (1994) cite the results of their initial use of PECS at the Delaware Autistic Program. Many of the children began to speak during communicative exchanges when they had acquired between 30 and 100 symbols. Out of the 66 preschoolers who used PECS for more than a year, 44 came to use speech alone to communicate and 14 more communicated using a combination of speech and symbol systems.

In the instances where the child begins to acquire some functional speech, they might neglect their PECS symbols and rely on speech alone. A common pattern noted by Bondy &

Frost (1994, citing Bondy, 1989) is for children who had no functional communication at the beginning of PECS training to gradually begin to acquire pictures, begin to use speech while also using pictures, transition into speech use, and eventually depend solely on speech. One student described by Bondy & Frost (1994), Billy, was assisted with his transition from symbols to words by his teachers, who removed the symbols for his clearest and most strongly-spoken words from his communication book; when he wanted to refer to those items, he used the spoken words instead. Bondy & Frost (2002) caution against removing all or part of a child's symbol system too soon after she begins to use words, as children who are just beginning to speak may not yet be able to produce spoken utterances at the level of complexity of their PECS utterances. Finally, Bondy & Frost (2002) point out that the language expressed through speech may not be those that are appropriate for the child's age, but is sufficient enough to be used in place of PECS.

While the development of speech is common with PECS training, the relationship of PECS to speech development is unclear. Did the child develop speech as a result of, or in some part a result of, their training with PECS? And, if so, what was it about PECS that facilitated language development? Yoder & Stone (2006b) suggest that PECS might facilitate language development (a) because caretakers provide more language input to children with developmental delays when they have a coordinate focus attention and (b) language input corresponding to the exchange just completed is provided after every picture exchange. It may also be the case that PECS intervention helps to build skills, such as joint attention, imitation, or receptive language, that aid the child in acquiring speech. On the other hand, is it possible that the child was going to develop speech at some particular mental age or point in maturation anyway? In this instance, PECS might have had nothing at all to do with the speech development that occurred, and simply

appeared to be implicated in the speech development because of its contingency with the onset of speech. The question of maturation is an important one in intervention; if children are simply developing language as result of elapsed time, then the selection of an intervention is not very important, or perhaps unnecessary at all. A third possibility is that PECS training was implicated in some way in the development of speech, but not in the manner in which it is assumed to be doing so. An example would be if the children participating in a PECS study received more attention and more rigorous language experience than they might have otherwise. In this instance, it might well be the extra input that helped the children to develop speech rather than the PECS training itself. These are questions that must be addressed by research in order to determine what the relationship between PECS and speech is.

In other instances, a child might excel at using PECS but never utter a word or acquire a manual sign. In this instance, the logical way to support the child's communicative development is to allow him to continue to use the system that works for him. Although communication via pictorial symbols is a time-consuming and relatively unproductive way to communicate, it is by far preferable to denying the individual the opportunity to communicate. There are a number of ways in which children can expand their linguistic abilities while continuing to use PECS symbols.

After a child has successfully completed Phase VI, Bondy & Frost (2002) recommend teaching the use of attributes – color, size, location, shape, quantity, temperature, texture, and cleanliness – as well as body parts and action words. If color coding, as recommended by Frost & Bondy (1994), is used to differentiate the different classes of symbols, then additional colors could be assigned to a third class for color, size, and other descriptors – which as adjectives would be placed between the function word and the content word – and to a fourth class for

locations – which as prepositional phrases would be placed after the content word. The color-coding would help the child to know which type of symbol should be placed in which location in the sentence and thus would serve as a very fundamental introduction to sentence structure. In my opinion, if a child had begun to use spoken words, then such a gradually-introduced sentence structure might help to transition her into spoken language; if the child did not give any indications of developing spoken language, the sentence structure would help to teach the child to make more elaborate utterances through AAC. Also, I feel that prepositional phrases of location should be taught by putting the entire phrase (e.g., on the table, in the closet) on one symbol, to teach the concept of describing location before attempting to break down the symbol into components (e.g., [ON] + [TABLE]). Starting off with whole prepositional phrases would also be more practical because preposition use is somewhat arbitrary in English. For example, one of the children described in Kanner (1943) demonstrated frustration with prepositions because the spatial configurations they represented were not consistent across their use.

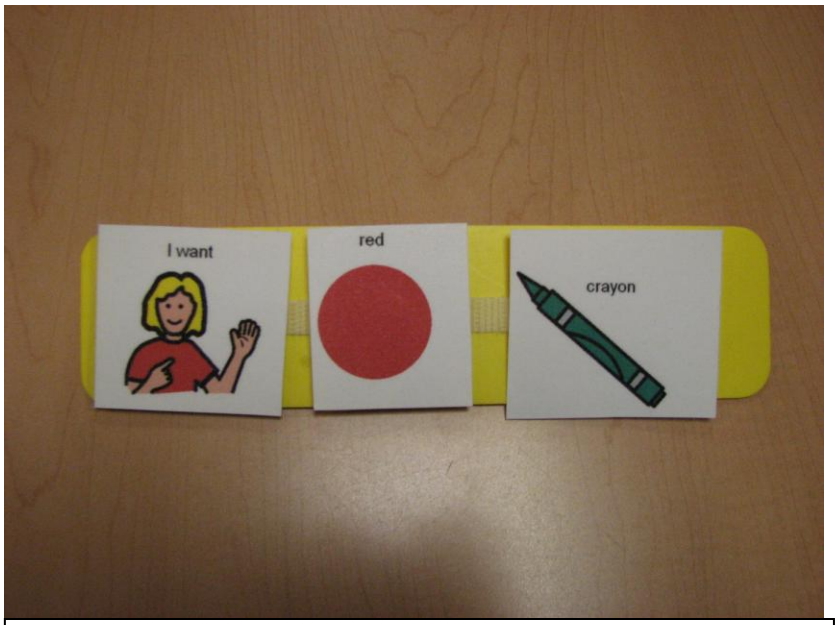

Figure 9. An example of a three-symbol utterance using three classes of symbols.

> His father said something about the pictures they have at home on the wall. This disturbed John somewhat. He corrected his father: "We have them *near* the wall" ("on" apparently meaning to him "above" or "on top"). (p. 239)

With a system containing four classes of words, the child could create gradually more sophisticated utterances such as:

- [I WANT] [GREEN] [BALL] – functionally useful in that the child will get what she wants even in a context in which there is more than one ball
- [I HAVE] [BIG] [DOG] – perhaps in response to the question, "What do you have?" in a context in which there are two dogs, one of which (the big one) the child has, and one of which he does not
- [I SEE] [RED] [TRUCK] [ON THE TABLE] – perhaps in response to the question, "What do you see?" in a context where there are quite a lot of trucks about the room

There is one note I would like make with regard to the use of adjectival and location modifiers.

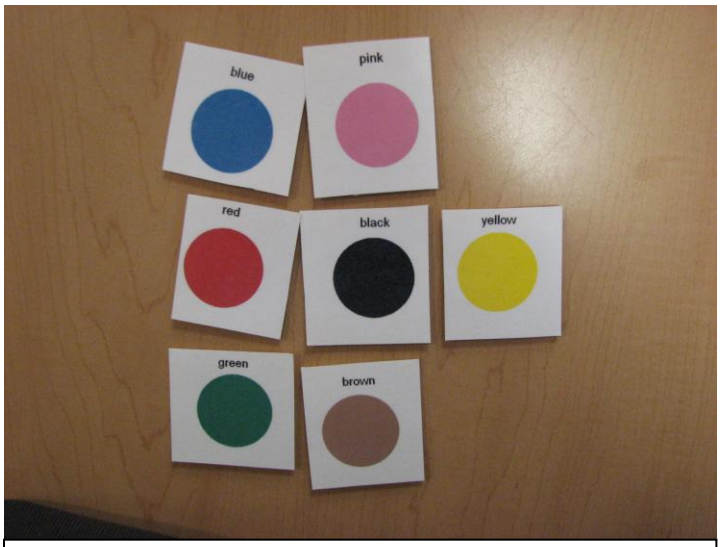

Figure 10. A set of Boardmaker symbols for colors.

In the world of people who develop language without extra assistance, we do not use unnecessary descriptors. Thus, to use an example from above, if there is only one ball in a particular situation – at school, for example – then it is unreasonable to expect the child to describe it as green; even a typically-developing person who uses speech would not refer to it as *the green ball* because *the ball* is sufficient to discriminate the intended referent. Thus, the situation must be manipulated in order to create an appropriate context for such an utterance, perhaps by introducing a red ball. Also, as Bondy & Frost (2002) describe, creating situations with contrasts will be necessary in order to teach the meanings of

some kinds of attributes, because the definition of the attribute is defined relative to other exemplars in the environment. The example they use is size.

> …how do we teach them to request things that are small? One way is to offer choices in which only the small item fits the situation. For example, if a child could request a spoon to eat pudding out of a small plastic container, giving the child a choice between a regular-sized spoon and the kitchen ladle[5] would increase the appeal of the smaller spoon. Of course, to be certain the child was selecting by the relative size of the spoons, we would later need to offer a choice between the regular spoon and Barbie's spoon! (Bondy & Frost, 2002, pp. 96-97)

Finally, Bondy & Frost (2002) also point out that the child's preferences must be taken into account when teaching attributes. If a child only likes red M&Ms, then it is pointless to try to teach the color blue by the child requesting M&Ms; something else, such as popsicles or Kool-Aid, that the child prefers in blue will be needed to teach this color. Thus, the situation in which additional language concepts are taught must be carefully considered so that it is pragmatically appropriate, so that the child can access the meaning of the new symbol, and so that the items used to present the symbol are intrinsically rewarding.

Another linguistic concept that can be introduced as part of the adjective class is numbers. I think that the child might be prompted to add a number word to her sentence strip in the adjective position when making a request for something that one typically receives in a quantity, such as pretzels, potato chips, or stickers, and then receive that many of that item from the trainer. It might also be useful for the trainer to count the items after the child has received them (i.e., "You asked for five pretzels. One, two, three, four, five [counting while indicating each item through gestures]") to emphasize that the number pertains to the quantity of the items rather than some other intrinsic quality. Although it would certainly be possible to create a plural symbol for the child to attach to the content word in such a sentence, in order for the symbols on

[5] Note: The success of this teaching strategy, which Bondy & Frost (2002) fail to mention, would depend on the ability of the child in question to generalize the symbol for [SPOON] to ladles and perceive these as members of a common semantic group. It also assumes that the child has not learned a separate symbol for ladles.

the sentence strip to more closely mimic the English equivalent, unless the child's goal is to develop correct spoken or written language this seems rather superfluous to me.

When teaching further linguistic concepts to children with autism using PECS, the fundamental approach of PECS – using reinforcers that are highly motivating to the child to encourage them to communicate – needs to be continued, because it is unlikely that social motivation alone will be enough. Some children, even after completing the six phases of the PECS protocol, may still have very little interest in communication. Thus, the additional linguistic concepts may have to at least initially be built into requests, so that the child will be motivated to use them (Bondy& Frost, 2002). I can easily think of situations that could be created for such requesting. For a child who likes cookies, one might be placed on a table out of reach and another in a drawer. The child would need to see this occurring in order to know what symbols to use. Then, when the child attempts to make an exchange with their sentence strip using [I WANT] + [COOKIE], he could be prompted to add [ON THE TABLE] to his sentence strip in order to receive the cookie. As with other stages of PECS, the prompting would then be faded until the child could add the additional symbols to their board in order to create three- and four-symbol utterances.

Furthermore, I think that once children become proficient in commenting and can learn new language concepts without needing to be rewarded with them, they might be able to dissociate the two parts of the [I WANT] symbol in order to make statements about someone else. In this case, separate symbols for [I] and [YOU] would be required in the child's symbol lexicon. However, some children may have difficulty acquiring these symbols because of the known pronoun difficulty with this population. For children who have difficulty acquiring symbols for pronouns, symbols might be created for the individuals with whom the child

typically uses his symbol system (e.g., [TYLER], [JESSICA], [MOM], [DAD], [MRS. JOHNSON]). This way, the child could refer to other people without the difficulty of determining the referent from context and make statements about others such as [MOM] + [HAVE] + [BOOK].

Other, more complex linguistic concepts could in my opinion also probably be represented through PECS, such as: negation, verbs requiring more than one complement, and recursion. However, when choosing linguistic concepts to introduce to the child, some questions should be considered first. One is, how will this concept be taught to the child? PECS training occurs within a functional context, so in order to usefully teach the linguistic concept to a child, a situation requiring it will need to be contrived. A second question is, is the child able to understand the linguistic concept? Although there is probably no certain way to answer this question without trying it, one way might be to consider what typically-developing children at the child's mental age are capable of expressing. Introducing language concepts that are too complex would most likely confuse and frustrate the child and possibly discourage him from communicating. Finally, a third question to ask is, how will the child use this language concept? If a functional context for that language concept to be included in the child's utterance does not exist, then it is not worthwhile to teach it to the child, because she will not use it.

In introducing more advanced linguistic concepts, there is also an issue to be addressed in how much the system is desired to appear consistent with the natural language(s) spoken by the child's parents, teachers, and peers. Some utterances might be expressed in a fairly straightforward manner, which those familiar with the child's symbol system might easily understand but which might be somewhat opaque to those outside the child's usual communicative partners. For example, if the child wanted to jump on the trampoline and a

symbol containing a visual representation of a trampoline with the word *trampoline* on it was typically used for this meaning, the utterance would probably appear as follows:

[I WANT] [TRAMPOLINE]

Literally, this utterance seems to mean that the child wants a trampoline. An outsider could probably infer that the child wants the trampoline in order to jump on it, but this is not explicitly stated in the utterance since [TRAMPOLINE] as used in the child's communication system appears to mean *to jump on the trampoline*. Although it is easy to infer the meaning of this utterance, it might be easier to represent certain linguistic concepts in a manner that is not consistent with English. For example, a child might be taught to ask a question simply by adding a symbol to mark the questioning function at one end or the other of the sentence strip, such as [WANT] [PRETZEL] [?][6]. Again, the correct meaning might be guessed, but the expression is not at all consistent with the English equivalent *Do you want a pretzel?* Thus, depending on the communicative goals for the child – learning more linguistic concepts in an easier manner, versus learning correct language – different ways of teaching these concepts might be relatively more or less desirable.

With regard to communicative acts, subsequent to (successfully) completing training in the six phases of the PECS protocol children have use of two communicative functions for initiating interaction (e.g., requesting and commenting) and one for responding to interaction initiated by another (e.g., answering questions). At this point, the child has acquired very rudimentary skills in communication. Of course, even very limited symbolic communication is desirable over none at all, especially since PECS communication might replace nonfunctional or even destructive behaviors that the child was previously using the express himself. But for those

[6] In this instance, the symbol for [WANT] would have to be dissociated from being solely used to mean *I want* before this question would make sense as *Do you want a pretzel?* Clearly the child knows if he or she wants a pretzel, so the meaning *Do I want a pretzel?* would not be a very useful one to teach to the child.

children who do successfully acquire the six phases of PECS, intervention should be developed to continue their communicative development. The basic PECS intervention does not provide children with the skills of turn taking required for sustaining an interaction; all of the PECS exchanges consist fundamentally of an initiation and a response, at which point the interaction ceases.

One way in which I think that communicative interaction might be gradually drawn out is in conjunction with the introduction of the advanced linguistic concepts described above. For example, a child might approach his teacher with the PECS sentence [I WANT] [BALL], presumably because he likes to play with balls and would like to do so. Rather than just giving the child a ball, the teacher might sustain the interaction by creating a situation in which it is appropriate for the teacher to respond with a question: the teacher could produce two balls, perhaps one red and one green, or perhaps a big ball and a little ball, depending on the semantic concepts that the child is learning. In this instance, the teacher can ask, "Which ball do you want?" If the child did not understand how to respond, he could be prompted to respond by revising his sentence strip to say [I WANT] [RED] [BALL] or [I WANT] [BIG] [BALL]. Although this interaction may seem a far cry from a genuine conversation, it is an interaction in which the child has now taken on the roles of both initiator and responder (or sender and receiver, in terms of the basic human model of communication), which is a small step in the direction of developing turn-taking and conversational skills.

Research suggests that PECS can also be extended to make it more productive. Marckel et al. (2006) examined the abilities of two children to learn to use picture-symbols of descriptors for objects that they wanted and for which they did not have available symbols to use. The resulting utterances were quite complex in comparison to many produced during the six phases

of the original PECS protocol. The children were trained on utterances such as “I want eat white square” for a sandwich or “I want watch green rectangle” for a video; they eventually produced requests like “I want play green circle” for toy coins and “I want eat brown rectangle” for sausage. The descriptors were taught using the same prompting, delay, and fading procedures used to teach other symbols. The children acquired a number of actions, including eat, drink, play, read, and listen; colors, including red, blue, green, pink, orange, brown, yellow, and gray; and shapes, including circle, square, triangle, star, line, and diamond. This approach reveals that, with appropriate resources, children can learn to use PECS symbols productively to describe items that they want. Teaching children to use descriptors allows them to refer to objects not yet included in their symbol lexicon, which relieves to a certain extent their dependence on their caregivers and therapists to provide them with appropriate symbols. Children can also be taught to use symbols for other functions such as asking for help, requesting a break from work, and expressing social greetings (Brody & Frost, 2002).

Despite the many possibilities for its use, over time PECS will likely become unwieldy. In the instance of the children in the Delaware Autistic Program, imagine having to carry around 100 symbols, plus the book that contains them and a board and sentence strip for communication. Assuming that the child will continue to acquire new symbol-words, the symbols will soon become difficult to transport. Also, if the child demonstrates a potential for more productive linguistic utterances, then perhaps a transition to a different kind of AAC system or device would best facilitate the child’s developing communication. Many of the children who worked with an autism specialist I spoke with transitioned from PECS to electronic devices with voice output (B. Craig, personal communication, November 29, 2010). What kinds of systems and devices will be useful to a child “graduating” from PECS, and how to

successfully assist the child in transitioning from one to the other, should also be the subject of research.

Research into the efficacy of PECS

Frost and Brody (1994) introduced PECS to the intervention community via a manual for teachers and parents to use with young children with autism. In this manual, they cited success with the children they initially used the system with in the form of mastery of PECS itself and of the subsequent acquisition of speech in a number of these children. However, this evidence is anecdotal and is of course being cited by the authors of the system. Since the development of PECS, many studies have sought to evaluate whether PECS works for children with autism. These studies have employed a number of types of methodologies, with varying degrees of validity for pinpointing the efficacy of PECS. In this section, I will briefly review a subset of the literature on the efficacy of PECS. This set of studies was selected from the list of studies included in the meta-analysis by Preston & Carter (2009). The selection criteria I used was that (a) the study included mostly participants with autism, even if not all of the participants had diagnoses of autism, (b) the primary focus of the study was PECS training, and (c) I was able to obtain the full text of the article through interlibrary loan.

Several studies simply examined data related to the acquisition of PECS by one or more children with autism (Bondy & Frost, 1993; Bondy & Frost, 1994; Bondy & Frost, 1998; Ganz & Simpson, 2004; Liddle, 2001; Malandraki & Okalidou, 2007; Schwartz, Garfinkle, & Bauer, 1998). These studies examined outcome measures such as the number of symbols acquired, the amount of time required to master particular phases of the PECS protocol, number of spoken words, and improvements in communicative and psychosocial behaviors. Another group of

studies used methodologies that compared outcome data with one or more baseline measurements (Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002; Frea, Arnold, & Vittimberga, 2001; Kravits, Kamps, Kemmerer, & Potucek, 2002; Magiati & Howlin, 2003; Tincani, 2004). These studies examined outcome measures such as speech, social-communicative behaviors, problem/agressive behaviors, mean length of utterance (MLU) in spoken utterances, and frequency of spontaneous communications, among other measures specific to the research goals of each study. Overall, these studies indicate that PECS can be learned by children with autism, but little more, due to low internal validity. In some cases, they indicated improvements in speech development and communicative behaviors, and reductions in problem behaviors, but without a control group it is impossible to say that the improvements were necessarily due to PECS intervention. They also generally provided very little information about their participants, other than age, thus making it difficult to determine what sub-populations of the broadly differing autism population might benefit most from the intervention or what underlying psychological abilities might be related to success with PECS.

Two studies from the list above that are frequently cited in the PECS literature, and which serve as good examples of the shortcomings of this body of studies, are those conducted by Schwartz et al. (1998) and Charlop-Christy et al. (2002). Schwartz et al. (1998) examined the results of PECS training in children attending an integrated preschool program, ranging in age from three to six years of age and diagnosed with a variety of developmental disorders. Training proceeded at individual rates for each child and continued up to Phase IV. These children also were taught to use their PECS symbols with their typically-developing peers. The authors examined the amounts of time it took for each child to learn each phase of PECS (which varied widely); the communicative forms used by the children over the course of PECS training

(gestures, vocalizations, signs, PECS symbols, speech); the communicative functions used by the children (requests, comments, protests, responses, and no communicative intent); whether communicative acts were prompted; and whether the communicative act was original or an imitation. It was found that the children could be organized into particular profiles of communicative functions and that some children developed speech while the others did not. Charlop-Christy et al. (2002) studied the effects of PECS on the development of speech and on social-communicative and problem behaviors. Three participants received PECS training twice per week for fifteen minutes in a variety of settings. Measures of the amount of time required to reach criterion in each phase; responses to spontaneous and imitative speech opportunities; mean length of utterance of each response; and rate of occurrence of communicative behaviors (communicative play, joint attention, eye contact, requesting, communicative initiation) and problem behaviors (tantrums, being out of their seat, grabbing, disruptions). There was found to be an overall improvement in the children's communicative behaviors and a decrease in the number of problem behaviors.

The studies described above are often cited as support for the efficacy of PECS. However, these interpretations are not necessarily correct. As Schlosser (2003) states, "…questions of methodological rigor are important in any research. In efficacy research, however, rigor has greater bearing because we seek to separate truly effective interventions from seemingly effective interventions" (p. 1). Thus, data suggesting that a particular intervention is efficacious may simply be a result of flawed methodology rather than actual efficacy. Schlosser (2003) goes on to say,

> The past and the current landscape of fine textbooks and other important monographs in the field of AAC tend, without notable exception, to proceed from research findings as stated by the authors of the original studies. Although it has not been the stated purpose

> of any of these works to evaluate the integrity of the research itself, any reliance on findings is a methodological acceptance of the "truth" of these findings. (p. 2)

Consistent with these sentiments, the above PECS research has tentatively indicated that PECS intervention is effective, but potential confounds in its methodology need to be accounted for before this can be conclusively stated. As Yoder & Stone (2006a) state, "this extremely popular treatment [PECS] has surprisingly little internally valid evidence of efficacy" (p. 427).

One of the methodological wrinkles that occur in PECS research is a lack of control for maturational effects. Children's lives do not stop while they are undergoing PECS intervention; they are still growing, learning, and developing in response to general life experiences in addition to the intervention they are receiving. Thus, without a control group of children who are initially similar in a number of characteristics (discussed below) to a group of children who receive PECS intervention, it is difficult to say whether the communicative acts and/or speech that the child begins to produce during the course of the intervention are actually a result of the intervention. It may be the case that many of the children would have begun to exhibit these behaviors even without the intervention.[7]

More recently, studies using control groups have begun to use control groups to eliminate issues related to causation and maturation. Two reports (Carr & Felce, 2007a; Carr & Felce 2007b) describe a study in which two groups were used, a PECS intervention group and a control group that received no intervention. Both groups attended similar kinds of schools in the United Kingdom; however, group membership was determined by geographical location, because researchers could only travel a certain distance regularly to provide intervention, thus the validity was not quite as good as an experiment with randomized controls. Although using distance to

[7] It is, admittedly, unlikely that every single child who demonstrated positive results subsequent to PECS training would have done so without it. Maturation is intended here as an example of a confound that might occur in research that is not controlled.

determine group membership introduced a potential confound into the study design, it did allow the intervention to be provided by the two researchers, which meant that intervention was consistent across participants. In addition to conducting a comparison between the two groups, the study also took a measure of performance change over a similar period of time prior to the intervention period to provide a within-subjects comparison of maturation of performance. Carr & Felce (2007a) report data related to initiation of communication by the participants. The results indicated that PECS had a positive effect on the total number of child-to-adult communication initiations, the number of child-to-adult communication initiations using some form of language, and the percentage of child-to-adult communication initiations to which the adult responded. However, there was no evidence for a significant increase in the responses of children to communications initiated by an adult, which suggests that the strength of PECS lies in teaching children to initiate communication rather than in teaching them to respond to and sustain communication initiated by another person. However, because neither the PECS group during the baseline period nor the control group during the treatment period exhibited increases in spontaneous communication anywhere near the amount demonstrated by the PECS group during training, it can more safely be inferred that the PECS intervention caused the increase in spontaneous communication.

A few randomized control trials (RCTs), which are "the gold standard for evaluating clinical interventions in areas such as medicine and education" (Preston & Carter, 2009, p. 1472) have also been conducted on PECS. Howlin et al. (2007) conducted an RCT of 84 children in specialized schools, using the classroom as the unit of randomization. The classes were divided into an immediate treatment group, which received PECS training immediately after a baseline period; a delayed treatment group, which received PECS training two terms after the conclusion

of the initial baseline assessment; and a no treatment group, which did not receive PECS training. The measures used were rates of communicative initiations, use of PECS, and speech in the classroom, as well as a number of standardized language assessments. The results indicated that the children who received PECS training initiated more communicative acts than controls and used PECS more frequently in those communicative acts. However, the effects did not appear to be maintained; at Time 3, well after the end of training for the immediate treatment group, the immediate treatment group demonstrated performance that was not significantly different from controls on the number of communicative acts initiated and use of PECS. Also, there was no effect of treatment on the rate at which the children used speech.

Another randomized control trial is reported by Yoder & Stone (2006 a,b). They compared a group of children with autism undergoing training with the RPMT (Responsive Education and Prelinguistic Milieu Teaching) method in comparison to a group undergoing training with PECS. RPMT focuses on spoken language and teaches declarative commenting via parent modeling, which the authors predict will only work for children who already demonstrate some joint attention behaviors, since these children are most likely already responsive to purely social motivators. This is in contrast to PECS, where the motivation to communicate is provided by the material reinforcement of the desired item that is requested. The authors' three hypotheses for the study, based on the above facts, were that: RPMT would better facilitate generalized turn taking (one of the focuses of the intervention); PECS would better facilitate requesting; and RPMT would better facilitate initiating joint attention, particularly in children who demonstrate some joint attention behaviors prior to treatment. With regard to the third hypothesis above, the authors stated that "this type of a priori prediction is an important step toward advancing the empirical basis for differentially treating children with ASD who have different characteristics at

study entry" (p. 427). The children in this study received six months of treatment, with treatment sessions occurring for 20 minutes each three times per week. The results indicated that RPMT did, in fact, better facilitate turn taking, though treatment category had no main effects on requests. Most importantly, the third hypothesis was confirmed; children who demonstrated more initiating joint attention behaviors at Time 1 benefitted more (i.e., demonstrated larger increases in the number of initiating joint attention acts produced) from RPMT than from PECS. Meanwhile, children who demonstrated very few initiating joint attention behaviors at Time 1 demonstrated larger gains with PECS. The interaction between treatment group and number of initiating joint attention behaviors had a large effect size. This study demonstrates that children with different characteristics can receive differential benefits from different interventions. It also provides an example of how research might, in the future, also address the underlying psychological changes that occur during PECS and influence the changes in the observable behaviors; as the authors state, "if replicated, then the effect of PECS on initiating joint attention may be the result of such children acquiring the prerequisite skill of coordinated attention to object and person through PECS use and learning that people can be rewarding through successful intentional communication" (p. 433).

A second analysis of data from the study described above also examined interactions between treatment group and preliminary characteristics of the children (Yoder & Stone, 2006b). This analysis examined the effects of the two interventions and of preliminary object exploration, defined as number of toys touched during the baseline observation period, on outcome measures consisting of: frequency of non-imitative acts, number of non-imitative words, and object-exchange turns. Within both treatment groups, the frequency of non-imitative spoken acts and the number of different non-imitative words increased at both Time 2, immediately after

treatment ended, and Time 3, six months after treatment ended, though this does not indicate that the increase was due to treatment, as another factor (amount of other therapies outside the study) significantly differed between Time 2 and Time 3. The results also indicated that children who were initially low in object exploration benefitted more (i.e., demonstrated greater increases in number of non-imitative words produced) from RPMT, while children who were high in object exploration benefitted more from PECS. The authors propose that this interaction effect was observed because, while both RPMT and PECS use objects as rewards for communication, only RPMT teaches play skills. Thus, children who are initially low in object exploration have less interest in receiving objects, and the play-skills component of RPMT may increase their motivation to communicate. This study provides another example of how measuring skills of children prior to treatment onset might, with sufficient research, be able to predict which treatments they will most benefit from.

Two recent meta-analyses have surveyed the results of a number of studies about the efficacy of PECS, including the studies listed above. Preston & Carter (2009) examined 27 studies of PECS, including pre-experimental designs, single-subject designs, multiple-baseline designs, quasi-experimental designs, and randomized control trial designs. They provide some criticism relevant to the studies above. Overall, the descriptions of the participants in these studies were poor. The studies did not provide information about the procedures used to determine a diagnosis of autism or another autism spectrum disorder. In addition, there was not enough data on intellectual functioning to allow for any kind of hypothesis about how it might relate to outcome subsequent to intervention. The studies also frequently failed to examine the maintenance of acquired skills. The authors of this meta-analysis also cited shortcomings in specific studies. For instance, although the studies by Yoder & Stone (2006a, 2006b) used a

control group to evaluate the effects of PECS, their control group was receiving a different treatment; thus, their studies did not provide any evidence of how well PECS works in comparison to no intervention. Also, the study conducted by Howlin et al. (2007) did not provide any measures of consistency across the schools implementing treatment, introducing a potential source of extraneous variation into the data. However, despite weaknesses in some studies, the authors of this meta-analysis draw a preliminary conclusion that PECS is an effective intervention when conducted under research conditions, particularly for providing a means to communicate through picture exchange. The influence of PECS on speech development is not yet clear.

The second meta-analysis was conducted by Flippin, Reszka, & Watson (2010). This meta-analysis was limited to 11 studies conducted with participants who had autism spectrum disorders and who were young children; other studies were excluded after failing to meet a certain criterion of quality. The meta-analysis addressed two research questions: (a) how does PECS influence communication outcomes for children with autism spectrum disorders, and (b) how does PECS influence speech outcomes for children with autism spectrum disorders? In the course of conducting the meta-analysis, the authors found that few studies, consistent with a general trend in the autism literature, included measures of generalization, maintenance, and social validity, which are necessary for clinicians trying to put together communication training programs for children with autism. PECS had a significant effect on communication outcomes, and based on measures of effect size is a "fairly effective" intervention. With regard to improving speech outcomes, PECS was found to not be equally effective for all children with autism. The authors note that the success of PECS with individual children might depend on characteristics of the child prior to intervention, and based on the literature reviewed propose

joint attention, object exploration, and imitation as possible mediating factors.[8] Overall, this meta-analysis found that PECS has small to moderate effects on the improvement of communication in children with autism and may help some children with autism to develop speech. The analysis provided by this meta-analysis probably differs from that provided by Preston & Carter (2009) mostly because it excluded many studies that Preston & Carter (2009) included.

To summarize, the primary research and meta-analyses listed above have some methodological weaknesses, such as a failure to use control groups. More recent RCTs provide firmer, though not yet conclusive, data about the effectiveness of PECS. The evidence taken as a whole suggests that PECS does have some positive effects on many aspects of the social, communicative, and behavioral development of many children with autism. However, some children demonstrate greater gains from PECS than others, and a few fail to acquire PECS beyond its earliest phases. Future research will need to investigate why these differential gains are observed.

Why does PECS work?

Most of the studies above, with the exception of two (Yoder & Stone, 2006a; Yoder & Stone, 2006b) solely examine the efficacy of PECS: whether children with autism can learn PECS and whether it produces effects on their social, communicative, speech, and problem behaviors (e.g., number of symbols learned, number of distinct spoken words produced). However, given evidence that PECS does have positive effects for many children, research on PECS should also move beyond the question of *whether* PECS works to the question of *why*

[8] A discussion of pre-treatment child characteristics that could possibly affect PECS outcomes, beyond the scope of the analysis of Flippin et al. (2010), is conducted below.

PECS works. Examining corollary factors such as joint attention and symbolic development would produce information that could contribute both to a better understanding of why PECS appears to work for some children with autism and an understanding of what kinds of children benefit most from it. Yoder & Stone (2006a) state that "there is consensus that the relative efficacy of one treatment over another is likely to vary by pretreatment child characteristics" (p. 427). Autism is a widely variable disorder, as discussed above, so having insight about what interventions are more likely to help children with particular characteristics (e.g., good receptive language skills but a poor understanding of communicative intention). This information would be invaluable to parents, clinicians, and educators who are trying to determine what kinds of interventions to provide to children who require it. The following section proposes some communicative and psychological skills for consideration as mediators in the outcomes of PECS and as predictors of a particular child's potential success with PECS.

One of the skills that could affect a child's outcome with PECS is their receptive language ability. PECS differs from natural languages is that it is only an expressive language form for the child who uses it. The adults interacting with the child may indicate the symbols when making a response – for example, pointing to or holding up the [COOKIE] symbol after the child has requested a cookie while saying, "Okay, I will give you a *cookie*" – but the adult or other interlocutor does not primarily use the pictorial symbols to initiate interactions or respond to overtures by the child. The interlocutor uses the natural language that is generally used in the language community to which the child and the interlocutor belong in order to interact with the child. This introduces a potential wrinkle into the appropriateness of the PECS protocol for some children; what if a particular child has extremely limited receptive language? Not being able to understand the speech of the people with whom she is interacting would impede the child's

progress in communication using PECS, because she would not be able to (or only to a limited extent) understand the feedback and responses that she receives. In addition to slowing a child's progress through the PECS protocol, limited receptive language ability would likely influence the outcomes that could be expected from PECS intervention; it seems reasonable to expect that a child with a receptive language limitation would be less likely to develop speech, because she would be gaining less from the spoken language input that she received. Many of the studies described above provided a minimal description of the children's language abilities at all, let alone receptive rather than expressive language, so it is difficult to say based on current research what the mitigating influence of variable levels of receptive language ability might be on the outcomes produced by PECS.

Another skill, this one cognitive, related to language development is the ability to understand symbols – not just PECS symbols in particular, but the concept of a symbol in general. Language, indeed any intentional communication, cannot occur without symbols to serve as the means to transmit information from one mind to another. Thus, a deficit in the ability to understand that one physical or abstract entity can represent another would certainly influence the ability of a child to acquire any communicative system. A child's failure to understand that words have meaning – or that he can convey meaning by using words – could contribute to a failure to develop spoken language. Furthermore, if a child could not initially understand that the [PRETZEL] symbol represented the salty, crunchy snacks that he liked to eat, then it is unlikely that he will quickly begin to use [PRETZEL] to request pretzels. It is to be expected that such a child would require much more time to achieve proficiency in PECS than a child who already developed the understanding that one thing can represent another thing. If measures of symbolic understanding were taken before, during, and after PECS training, then the

results could not only be brought to bear on the question of whether symbolic understanding influences the rate at which children acquire PECS, but also whether PECS training might influence the child's understanding of symbols. Since the child is being systematically trained to use a symbol in a manner that brings about a specific outcome, it seems logical that PECS training would promote development of an understanding of symbols and how to use them. As for receptive language, there is a lack of information regarding the influence of PECS on symbolic understanding in the current literature. None of the studies mentioned above provide an explicit measure of the abilities of these children to use symbols to derive or communicate information, other than what might be included in the general developmental assessments used in some of the studies.

One psychological skill set that appears to be closely related to language development is joint attention skills. When sharing joint attention, "children and adults coordinate their attention to each other and an object of mutual interest" (Carpenter & Tomasello, 2000). According to Carpenter & Tomasello (2000), the social-pragmatic approach to language emphasizes that children learn language in the context of their social experiences, and thus their ability to learn language is influenced by their ability to attend to and participate in the social world that surrounds them. When children are determining what the words they hear mean, they assume that the words are relevant to the activity in which the words occur, and so begin to associate words and referents. The amount of time that children spend in joint attention activities is correlated with their language ability in both comprehension and production (Carpenter, Nagell, & Tomasello, 1998, cited by Carpenter & Tomasello, 2000); this suggests that the two are linked. On the other hand, measures of non-social cognition did not correlate with language ability and joint attention, suggesting that the parallel increases in those two areas do not derive

from a general developmental cognitive leap, such as an increase in attention span. A further piece of evidence that joint attention skills and language development are linked is that children develop several joint attention-related activities, such as gaze following, social referencing, and perception of intentional action, around the same time that language development begins to occur rapidly, around the first birthday. Thus, according to Carpenter & Tomasello (2000):

> Our view is thus that the acquisition of linguistic symbols begins during this same developmental period quite simply because comprehending and producing language relies on the same basic understanding of individuals as intentional agents as do all of the other social-cognitive and cultural learning skills that emerge at this same age. Language tends to follow the emergence of the more straightforward expressions of joint attention skills such as gaze following and imitation because it requires a special application of these skills both to understand the special form of intentions known as communicative intentions and to engage in the special form of imitative learning known as role-reversal imitation. Thus, we believe that disruptions to the foundational joint attention skills that normally emerge at 1 year of age will have dire consequences for many aspects of children's language acquisition and use. (p. 40)

Children with autism grow up in the same world as typically-developing children, but they generally have marked difficulties with skills related to joint attention and attend less to social stimuli. Thus, since joint attention is impaired, the hypothesis goes that the child's ability to infer the meaning of language and use it will be impaired, and thus lead to the language impairments observed in children with autism.

How does joint attention apply to PECS? PECS does not require that children have mastery of joint attention skills. In PECS, the child is prompted through an exchange until he eventually comes to associate the act with the outcome, without any social inferences required. Thus, it seems that the child might be able to learn the communication system by association alone, rather than by experience in social situations as typically-developing children do. However, a successful PECS exchange does eventually require (in Phase II) that the child gain the adult's attention and give them the symbol, an external object, in close contingency.

Therefore it is possible that the child might take note that directing the adult's attention to an object – in these situations, the symbol – to which the child is also attending has an effect on the world. In rapid succession, the child and the adult are both attending to the symbol. This approaches, though does not really achieve, a situation in which the child and the adult share joint attention toward an object. If joint attention is so crucial to language development, then perhaps if PECS somehow facilitated the development of joint attention skills, then an interaction between the availability of a communication system and the improvement of prelinguistic skills that underlie communication might propel the child toward more advanced communicative development. Whether PECS actually has any effect on joint attention skills – or whether communicative development proceeds entirely by association – could be investigated by taking measures of the joint attention skills of children before they begin PECS training and at various points during training. Comparison of improvements in communicative ability – for example, increases in number of symbols acquired or increases in number of interactions initiated – with improvements in joint attention skills could indicate an ongoing relationship between the two domains in either direction. That is to say, if joint attention skills begin to rapidly improve before an increase in vocabulary, then improved joint attention skills could be implicated in the vocabulary growth; on the other hand, if the improvement in communication skills occurs first, then the communication skills might be influencing the development of joint attention. One study (Leew, 2001, cited by Yoder & Stone, 2006a) found that intervention for requesting and turn taking taught children behaviors, such as pointing and looking back and forth between an object and partner, that some of the children generalized to joint attention activities. This suggests that communication intervention could influence joint attention skills, and whether an intervention can develop related psychological skills like joint attention will have an effect on

the ultimate levels of communicative ability that the child is able to achieve. Only two of the studies (Charlop-Christy et al., 2002; Yoder & Stone, 2006a) examined the effects of PECS on joint attention. Charlop-Christy et al. (2002) did not examine the effects on joint attention separate from effects on overall social-communicative behaviors, but did find increased levels of social-communicative behaviors during treatment for the three children they studied. The other study, Yoder & Stone, 2006a, found a significant effect of treatment on initiating joint attention behaviors. Thus, although there is little data, the current evidence suggests that PECS might in fact influence communicative behaviors via improvement of joint attention skills.

Some research (e.g., Frost & Brody, 1994, among others) indicates that some children who learn PECS begin to use speech during the course of their PECS intervention, but it does so without much investigation into the speech and language abilities of those children prior to intervention. Detailed language profiles should be taken on children prior to beginning studies of PECS efficacy in order to determine the speech and language skills the child has actually acquired during the intervention. Children who have no functional speech might still vary quite a bit in their communicative abilities. For example, Child A might be totally nonverbal, but have a few sign approximations that he uses to indicate a few needs. In this instance, the child might just not have the motor control to produce speech sounds or manual signs, and might acquire PECS very rapidly if he already understands some basic communication concepts. On the other hand, Child B might be quite vocal – for instance, producing a lot of echolalic or irrelevant speech utterances – but unable to use any of the speech to achieve a functional goal. In this case, it might take this child a much longer period of time to learn the early stages of PECS, as she still needs to learn basic rules for communication; subsequent to mastering the early stages of PECS, however, it would not be surprising if this child began to use speech in parallel with or in place

of the PECS symbols. Thus, the speech and language skills that the child already has may predict what kinds of outcomes she achieves and how quickly she achieves them. Knowing whether this is the case would better inform research as to how PECS influences the language development of children with autism and would also allow parents and clinicians to better select interventions for a child based on the goals set for that child.

Like language skills prior to intervention, knowing about the child's ability to imitate – in particular, vocally imitate – might allow for prediction of that child's outcome subsequent to intervention. PECS is different from many other communication interventions in that it requires no ability to imitate; the motor behaviors that are required to complete a picture exchange can be taught to the child via direct physical prompting. However, it is very difficult to physically prompt the motions required to produce speech. Thus, imitation skills would be required. Many studies have found a deficit in the ability of children with autism to imitate body movements, including the oral-facial movements that would be required to produce speech (Rogers, Cook, & Meryl, 2005). Charlop-Christy et al. (2002), who noted increases in spoken language subsequent intervention in their study of PECS efficacy, anecdotally reported that the children involved in their study had some imitation abilities, which might have promoted the development of speech. Recording measures of imitation ability prior to beginning PECS intervention would allow for investigation into whether children who display better imitation skills are more likely to develop speech during the course of PECS training.

One factor that is broadly considered in many intervention approaches to autism is that of overall cognitive ability or intelligence. Frost & Bondy (1994) reported that for the population of students with which they piloted PECS, "overall communicative and education prognosis for students is also strongly related to their overall level of intellectual functioning" (p. 30). While

their definition of intellectual functioning, or how they measured it, was not mentioned, measures of cognitive ability do have a place in intervention research. Interventions such as PECS are designed to help children acquire skills or variations on skills that they were not able to acquire unassisted in the manner that typically-developing children do. It may be the case that children who have higher IQs or have overall better functional skills may be able to acquire systems such as PECS more quickly. This information would be useful to have, not in order to discourage the use of the system with lower-functioning children, but rather to demonstrate the additional time and/or trials required by lower-functioning children to acquire skills. Having information about differential rates of acquisition may encourage a child's parents and clinicians to continue to pursue a particular intervention even if results are not quick and dramatic, because the skills may come eventually in the long run. Only a few of the studies described above include measures of cognitive or overall functioning in their baseline assessments.

A final variable internal to the child that should be considered in PECS research is that of the ability to understand intentions. As Carpenter and Tomasello (2000) write, if a child cannot understand communicative intentions, then:

> "…language would simply be semirandom sounds that came out of others' mouths (the sounds would not be completely random because sometimes they might be associated with certain objects or situations). If such children were to speak at all, their speech would be limited to a small number of familiar nouns or phrases, learned associatively or through training and reinforcement, which more often than not would involve highly motivating, imperative situations (e.g., "I want juice"); this type of speech is characteristic of a subset of children with autism." (p. 45)

Thus, understanding the intentionality behind language is crucial in developing functional language. Carpenter & Tomasello (2000) also state that, in order to acquire a communicative symbol, children must be able to both determine what the communicative intent of the speaker is, and perform role-reversal imitation in order to use the symbol appropriately toward the adult as it

was used toward the child. While the communicative symbols used in PECS are not acquired this way – the behavior of making an exchange is learned via direct prompting rather than observation, understanding, and imitation – it is not impossible that PECS training may help to develop an understanding behind the intentionality of communication in children with autism. Even if they do not yet understand or are able to read the intentions behind others' communicative actions, PECS may help children with autism to learn that they can intentionally use communicative symbols to obtain what they want. Olsson & Granlund (2003) state that intentionality is an important issue in intervention for presymbolic communicators, though it is frequently difficult to judge intentionality in persons with severe disabilities because the behaviors that express intent, an internal state, may not be the same as in typically-developing individuals. Through PECS, children produce systematic and consistent changes in their environment. This has the potential to teach them that they can use particular communicative behaviors to bring about desirable changes in their world, which is the basis for developing intentional communication. Examining the abilities of children learning PECS to perform communicative behaviors with intention and to understand the communicative intentions of others will allow for an understanding of how PECS affects the development of understanding of communicative intention. This will be useful for furthering the theoretical understanding of how children with autism acquire functional communication and can in turn be used to improve communicative interventions with regard to the development of this skill. None of the studies described above examine children's abilities to understand intentions.

Overall, research on children learning PECS could be much improved by taking baseline and post-training measures of the skills and abilities described above. Knowing, for example, what the communicative outcomes are for children with particular levels of receptive language

ability or symbolic ability will allow parents and clinicians to better select the interventions that are appropriate for their child, and perhaps even to combine interventions in different areas (e.g., perhaps receiving both PECS training and intervention in joint attention skills) to allow the child to develop the best possible socio-communicative abilities. Furthermore, on a theoretical level, knowing this information would allow researchers to study what kinds of interventions produce the best outcomes in children with different initial characteristics and perhaps to better understand the nature of the communicative deficits created by autism.

Other factors that could affect outcome

In addition to studying psychological and communicative skills of the child as variables affecting PECS outcome, it is important for research on the efficacy of PECS to also consider the effects of factors external to the child. As with any intervention – whether for autism or another disorder, and whether involving communication or another functional skill – PECS does not operate in a vacuum. The children who undergo PECS training also have experiences at school, at home, in activities, and in other therapeutic settings that could potentially influence their communicative outcome. There are also variables within the application of the PECS protocol that should be considered, and which currently are mostly not being considered.

There are a wide variety of interventions available for the many difficulties and deficits that children with autism have. Some of the interventions used for communication, such as sign language and speech training, have already been discussed above. There are interventions intended to modify behavior, to improve social skills, and to help children adapt to school settings as well. Children may also be receiving treatments intended to improve gastrointestinal function, eliminate dietary complications, relieve allergies, or remove heavy metals (Wozniak,

2010b), all of which are believed by some to be related to autism, in addition to any medical treatments they might be receiving for conditions unrelated to their autism. Thus, there may be a lot going on in the life of a child with autism. Keeping some kind of record of the other treatments that a child is undergoing concurrently with PECS training, or received prior to it, may allow insight into why children respond differently to PECS. For example, perhaps children who have received speech training prior to or concurrently with PECS are more likely to develop speech. Or perhaps children who are undergoing a particular behavioral intervention acquire skills in PECS more rapidly. If any such interactional effects occur, knowing about them and being able to take advantage of them would be a great asset to parents and professionals attempting to determine what the best combination of intervention approaches is for their child. Three studies (Magiati & Howlin, 2003; Yoder & Stone, 2006a, 2006b) mentioned recording data on other interventions the children were receiving outside the study, but only Yoder & Stone 2006b performed any analysis on potential influences these interventions might have had; they found that, like their dependent measures, the amount of treatment had significantly changed over the course of the study, which could have potentially affected their results. On the other hand, the studies that examine only children from a single school or program confound the effects of that particular educational program with the effects of the treatment (Bondy & Frost 1994; Charlop-Christy et al., 2002; Liddle, 2001; Schwartz, Garfinkle, & Bauer 1998). For example, the study conducted by Bondy & Frost (1994) was on students attending school at the Delaware Autistic Program. While details about this program were not presented, it is possible that a generally better-informed approach to educating children with autism, or a better availability of support services, might have influenced the ease or rapidity with which the children in the program acquired PECS or other functional, social, or communicative skills. Of

course, the studies that examined only one participant (Bondy & Frost, 1998; Frea et al., 2001; Kravits et al. 2002; Malandraki & Okalidou, 2007), even with baseline measures, cannot wholly eliminate the possibility that educational experiences and/or other interventions are influencing the dependent variables.

Characteristics of the PECS training itself should also be recorded, as these vary across implementations of the PECS protocol. One variable that should be recorded is how much time is spent on PECS training per week. It is to be expected with any intervention that a child who receives ten hours of instruction per week will progress more rapidly than one who only receives two. This will in turn affect how rapidly the child acquires each phase of the PECS protocol, which is data that is frequently collected. Knowing that Child A learned Phase I in a week while Child B required a month actually says very little about the usefulness of the intervention; perhaps Child A spent ten hours on Phase I that week, while Child B, who spent two hours per week on PECS, actually received *less* exposure to the system. Thus, the intensity of the PECS training must be considered in addition to the duration when the rapidity or ease of acquisition of the system is being considered. A comparison of findings in the research literature indicates that the length of time the studies are conducted is an important piece of information. Both Howlin et al. (2007) and Kravits et al. (2002) cited no increase in speech in their participants; however, some data have indicated that speech increases are generally seen only after use of PECS for a year or more (Bondy, Hoffman, & Glassberg, 1999, cited in Kravits et al. 2002). The Howlin et al. study lasted for about 7 months and the Kravits et al. study lasted about 6 months – thus, if the research on speech development in PECS is correct, then the fact that no speech was developed in the course of those studies is unsurprising! Thus, factors such as time and intensity

must be taken into account when considering the results of multiple studies, as the studies may not be comparable and superficially produce contradictory results.

A second characteristic of PECS training that should be recorded is the environments in which PECS training occurs and the system is subsequently used. Some children may only be working on PECS with their classroom teachers at school in the classroom, while others may be learning how to use their communication boards in situations across home, school, and community environments. Only learning how to use a communicative system in one environment is a very poor re-creation of the communicative opportunities available to typically-developing children, who can communicate via speech with virtually anyone they meet in any environment. It is hardly fair to expect children with autism to generalize their communication systems to more than one environment if they never use them anywhere but in the classroom. Thus, in order to draw any conclusions across studies about the readiness of acquisition and the ease of generalization that children using PECS demonstrate, the environments in which they are instructed in and use their communication boards need to be taken into account. While a number of studies attempted to influence generalization by including training with a number of people in many different environments with a number of different reinforcers, only three of the studies (Tincani, 2004; Yoder & Stone, 2006a; Yoder & Stone, 2006b) actually included a measure of generalization. If PECS cannot be generalized to situations or individuals outside of the original training situation, it is of limited usefulness to the children who are being trained to use it; thus, generalization probes (i.e., providing opportunities for the child to spontaneously use their communication system in untrained environments with people who were not involved in their training) should be incorporated into research to ensure that the system is being used by the child across situations.

Overall, the best empirical evaluation of PECS will be the result of not one study, but of many studies examining children across degrees of ability, access to other interventions, and intensity of PECS training. Only if all of the important variables involved in learning, generalizing, and maintaining PECS are included in each research can these studies be combined and examined as a whole in order to derive the "big picture" of how effective PECS is for children with autism. Otherwise, trying to derive information between studies – which might examine, respectively, children learning PECS for two hours a week and only at school to children learning PECS for ten hours a week and across all of their daily environments – will result only in the comparison of apples and oranges, with nothing to be gained from the effort.

Summary

The research that has been conducted on PECS suggests that the system can be implemented to teach communication skills to children with autism, and in some instances will produce secondary results such as reducing problematic behaviors and promoting the development of speech. Future research should examine factors related to intervention both internal (e.g., joint attention) and external (e.g., interactions with other interventions) to the child; in doing so, researchers will be able to enlighten clinical practice as to which children will be best suited to receive PECS intervention, what results can be expected from that intervention, how the intervention should be conducted to produce the best outcomes for a particular child, and why the intervention produces the results that it does.

Conclusion

Upon superficial consideration, PECS may seem like a very crude way to teach communication to children with autism – after all, how productive can a system that uses pictorial symbols really be? However, what distinguishes PECS from other communicative interventions for children with autism, and what drew me to the system as the topic for my thesis, was the way in which the system is taught: how it teaches the children not just a form of communication, but also how to use the system with other people. This facet of PECS is also emphasized by the creators of PECS and researchers investigating the development of communication in children with autism:

> A variety of behaviors (sometimes identified as "prelinguistic") do not seem to develop normally in children with autism or similar handicaps (e.g., eye contact, appropriate facial expressions, voice intonation, etc.). We believe it is critical to rapidly establish the essence of communication for a child, namely, approaching a communicative partner and interacting in a manner that effectively results in that partner's doing something for the child. The 2- or 3-year-old child with autism does not have a successful history of using vocal behavior in this manner. (Bondy & Frost, 1994, p. 15-16)

> It is important for clinicians and parents to think about language and communication in a more cultural, social-pragmatic way, as opposed to teaching and rewarding associations between words and objects. (Carpenter & Tomasello, 2000, p. 48)

In other words, because children with autism by definition have difficulty understanding and participating in social interactions, they cannot be expected to learn how to use language automatically as a resulting of learning words and phrases. While PECS teaches a limited number of communicative functions (e.g., requesting and commenting), it does so in a way that appears to be able to break through the social difficulties that children with autism have and allow them to begin to acquire the rudimentary social-communicative behaviors (e.g., initiating interactions, getting the attention of another person) that they previously lacked.

In the course of learning the six phases of the original PECS protocol, children begin to learn some of the rudiments of linguistic behavior that their typically-developing peers acquire by the age of about 18 to 24 months. For example, children using PECS (during training for the six original phases) primarily have words for objects in their lexicons in addition to a limited number of function words. With regard to syntax, they can only combine two symbols to create simple sentences. The functions that they know how to use their symbols for are also limited: just requesting and commenting. However limited the language skills that PECS may offer, however, these skills are in many cases an incredible improvement over the abilities the child had previously. The parent of a child participating in one efficacy study (Schwartz et al., 1998) commented that PECS seemed to turn on a "light for communication" for their child (p. 157). The value of such a breakthrough cannot be overstated.

In addition, some research indicates that once this "light for communication" is ignited, it can be built upon, even if the child does not begin to speak. The experiment performed by Marckel et al. (2006) demonstrates that children can be taught to use PECS symbols for attributes productively. An extension of PECS conducted by Schwartz et al. (1998) taught children with autism in an integrated preschool program how to generalize their use of PECS to communicate with their typically-developing peers. When children do start to speak while using PECS, PECS can serve as a bridge to more advanced language concepts; one child described by Bondy & Frost (2002) was provided with a symbol for the *–ing* morpheme to support its use in his speech during his transition from PECS to spoken language, because he was having more trouble with this morpheme than with others in his speech. Thus, while the original PECS protocol is limited, it clearly provides a foundation upon which clinicians can creatively introduce increasingly challenging language skills as the child is ready for them.

Research on PECS tentatively indicates that it provides an effective way to develop communication skills in children with autism. While PECS may not be the best intervention for all children with autism, some of the lack of certainty about the efficacy of PECS is due to poor methodology in research designs and a pervasive lack of control groups; better research design would permit researchers to ascertain that PECS is responsible for the improvements seen in many children. Research that is better-designed, more thoroughly documents characteristics of its participants and intervention procedures, and extends its focus to why PECS might benefit children will give clinicians the information and data that they need to implement PECS as a best-practice intervention for children with the appropriate characteristics.

Autism is in many ways still a mystery. Its precise cause is unknown and there is no treatment guaranteed to help individuals with severe social and communicative impairments. However, with the continual development of new and improved interventions, the toolbox of clinicians grows ever more sophisticated. PECS is already a useful tool in this kit; with further development and research, professionals conducting intervention with children with autism will be able to employ PECS as a highly targeted, personalized tool in many children's intervention programs.

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