Effects of the Picture Exchange Communication System (PECS) on Maladaptive Behavior in Children with Autism Spectrum Disorders (ASD): A Review of the Literature

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Abstract

This paper provides an overview of the literature investigating the functional relationship between the use of the Picture Exchange Communication System (PECS) and maladaptive behavior (i.e., aggression, tantrums) in individuals with autism spectrum disorders (ASD). Digital searches were conducted to identify single subject design studies published between 1994 and 2012. While nine studies were identified, only three explicitly addressed the collateral effects of PECS training on reduction of maladaptive behavior. Of the seven participants across these three studies, four demonstrated an inverse relationship between PECS exchange and reduction of maladaptive behavior. Results are promising in terms of functional communication. However, the authors suggest caution due to limited number of publications to date.

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Autism Spectrum Disorders (ASD) have been characterized by impairments or delays in social interaction, communication, and restrictive or repetitive behaviors (American Psychiatric Association, 2004). More recently, the Diagnostic Statistical Manual, fifth edition (American Psychiatric Association, 2013) collapsed these three domains into social communication/interactions and restricted/repetitive behaviors. By virtue of diagnostic criteria, individuals with ASD possess challenges in the area of communication, which may be described as compromised in the ability to send, receive, or process symbols (American Speech-Language-hearing Association, 1993). Language is a symbolic system (Bloomfield, 1914). Having stated the aforementioned, one may consider *effective* communication as communication which is efficiently conveyed across individuals and environments, without need for repair (i.e., functional speech).

While the specific percentage of individuals with ASD who are effective communicators is uncertain, it is estimated that up to 50% of individuals with ASD are not functional communicators (National Research Council, 2001; Centers for Disease Control and Prevention, 2007). Mirenda (2003) described a functional communicator as one who can generalize communication across people and settings over time. Children with ASD, who may not demonstrated functional communication, may instead engage in maladaptive behavior (e.g., tantrums, self-injury or aggression) as a method of communication (van der Meer & Rispoli, 2010). When such behaviors are observed, clinicians may utilize Functional Communication

Training (FCT) (Carr & Durand, 1985; Tiger, Hanely, & Bruzek, 2008) in order to replace said behaviors with a more appropriate means of communication (i.e., verbal speech or Augmentative Alternative Communication).

When working with individuals with ASD who are not effective (i.e., functional) communicators, Augmentative Alternative Communication (AAC) may be implemented to either support existing communication patterns (i.e., function as an adjunct to verbal speech), or in lieu of verbal speech completely (American Speech-Language Hearing Association, 2007). The Picture Exchange Communication System (PECS) (Frost & Bondy, 1994) is an iconic AAC system developed to increase functional communication by way of requesting and initiating. The goal of PECS is to teach a functional relationship between communication and the environment (Frost & Bondy, 2002; Charlop, Malmberg & Berquist, 2008). More specifically, PECS utilizes a systematic approach to teach children how to exchange icons in order to effectively communicate. PECS is composed of six phases. The responses range from exchanging a picture to obtain a desired item during Phase 1, to answering simple questions and reciprocating comments at Phase 6. Although PECS is used widely clinically, there is a continued need to conduct and analyze research in an effort to objectively evaluate the efficacy of this intervention strategy.

Several literature reviews have been recently published regarding the use of PECS (i.e., Flippin, Reszka, & Watson, 2010; Subramanian, & Wendt, 2010; Preston & Carter, 2009; Hart & Banda, 2010; Ostryn, Wolfe, & Rusch, 2008; Lancioni, et al., 2007). These reviews have focused on PECS research that utilized various research design types (i.e., single subject, group and mixed), as well as different adaptations of the PECS protocol, and staff training and implementation of PECS use.

Flippin, Reszka, and Watson (2010) conducted a meta-analysis review of the current empirical evidence for effects of PECS on communication for children with ASD. Including both single subject and group designs, Flippin and colleagues (2010) reported gains in communication, by way of increased frequency of exchanges, initiations and requests. Preston & Carter (2009) conducted a review of efficacy of PECS intervention using both group and single subject designs. The researchers determined that the present body of literature investigating the effects of the use of PECS on development of verbal speech remain to be unclear (Preston & Carter, 2009). Hart and Banda (2010) conducted a review focusing on single subject research studies. They examined the use of PECS with children with developmental disabilities. They noted the limited implementation of PECS in inclusive environments. Ostryn, Wolfe, and Rusch (2008) conducted a literature review and analysis of use of PECS, operationalizing the notion of communicative competence in the domains of generalization, spontaneous communication, and maintenance. They noted a critical shortage in the literature, particularly as it pertains to individuals with ASD and functional communication. Lancioni and colleagues (2007) conducted a systematic review of the literature, evaluating outcomes of both PECS and Voice Output Communication aids (VOCAs). They asserted that PECS and VOCAs are both similarly effective communication systems for individuals with developmental disabilities who are nonverbal. They further asserted that a majority of the work reviewed was descriptive in nature, motivating the need for more experimental research. Collectively, these works have contributed to an increased understanding of outcomes of use of PECS with individuals with disabilities.

Previous literature reviews have been conducted using a variety of research designs (i.e., group, single subject and mixed designs). The current literature review focused solely on studies that employed single subject research designs. This method was employed in order to allow for a consistent examination of variables across each of the studies. While previous literature reviews have focused on the effects of PECS on communication, discussion of the collateral effect of PECS on challenging behavior reported in the individual studies has been (potentially inadvertently) overlooked. The connection between functional communication and the prevention of challenging behavior is crucial for individuals on the autism spectrum. Therefore this lack of empirical examination of the effects of PECS on the reduction of maladaptive behavior in the literature must be addressed. A small number of research articles to date have looked at this very important issue. For example, Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet (2002) reported decreases in problem behavior in three individuals with ASD who were trained using the PECS protocol. Frea, Arnold, & Vittimberga (2001) reported a reduction in maladaptive behavior in one participant as s function of PECS training. While studies such as these have been included in literature reviews, the impact of PECS on behavior change has not been highlighted as a main point of discussion. Literature reviews to date have not specifically analyzed the effect of PECS intervention (alone) on behavior change in individuals with ASD (Wendt, & Boesch, 2010).

The purpose of this literature review was to evaluate the scientific research base of PECS research with individuals with ASD using single subject research. The objective was not only to review published research in the context of increased communication and PECS, but specifically to examine the effects of PECS use on the challenging behavior of the individuals within these studies. This work expands the existing literature reviews in the following ways:

1. This work is a literature review of the use of PECS *exclusively* for individuals with ASD, including only single-subject design, and

2. This review measures the effects of PECS on *behavior* as well as communication.

Method

Studies identified for inclusion in this review underwent a three-step process. First, a search was completed using the search engines, including PsychInfo, ERIC, Pubmed, Academic Search Premier, Science Direct. Keywords included in the search were “Picture Exchange Communication System,” “PECS,” “Autism Spectrum Disorder(s),” “ASD,” “Speech,” “Behavior,” and “Communication,” with publication years between 1994 and 2012. This yielded 72 articles. The second step in this process was to exclude articles that did not use a single-subject research design. This further reduced the cohort of articles from 72 in step one to nine. The third step in this literature review was to review the official PECS website managed by Pyramid Consultants for any further pertinent research articles that should be included in the study. No further studies were identified with this review. The final number of single-subject articles analyzed in this literature review was nine. See Table 1.
Table 1. Single subject studies investigating the use of PECS.

Study	Number of Participants	Age(s)	PECS Phase(s)	Dependent Variable(s)	Results
* Frea, Arnold, & Vittemberga, (2001)	1	4;0	I-III	Picture exchange & aggression	Aggression significantly decreased when introduced to PECS exchange.
*Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, (2002)	3	3;8-12;0	I-IV	Independent PECS exchanges verbal speech, social-communicative behavior, aggression/undesired behavior	Speech and social communicative behaviors improved across all participants. Decrease in maladaptive behaviors across participants.
Ganz, & Simpson, (2004)	3	3;9-7;2	I-IV	Proficiency with each PECS phase, number of intelligible words, presence of non-contextual vocalizations	Mastery of PECS and observed increase in spoken words.
Markel, Neef, & Ferreri, (2006)	2	4-5	n/a	number of improvised requests based on trained stimuli	Number of independent improvised requests increased for functions, shapes, and colors.
Angermeier, Schlosser, Luiselli, Harrington & Carter, (2008)	4	6-10	I-III	Percentage of correct requests	Mastery up to Phase II.
* Ganz, Parker, & Benson, (2009)	3	3;2-6;0	I	Picture use, word use, maladaptive behavior	2/3 participants began using verbal speech. Increase in initiations observed across all 3 participants. No clear impact on maladaptive behavior.
Jurgens, Anderson & Moore, (2009)	1	3;7	I-IV	PECS mand, verbal mand, verbal initiation other than Mands, mean length of Utterance, functional play	Increase in verbal social-communicative behaviors with verbal mands. Increase in vocabulary and mean length of utterance, increase in duration of developmentally appropriate play.
Dogoe, Banda, & Lock, (2010)	3	3;8-5;1	I-III	Requesting desired items/ objects, generalization of PECS requesting up to Phase IIIB.	All 3 participants mastered PECS use up through Phase IIIB. Use of PECS was generalized across persons, settings, and stimuli.
Travis, & Geiger, (2010)	2	9;6-9;10	I, IV, VI	Number of requests in structured and unstructured Environments.	Increase in requests, increase in phrase length, increase in commenting (during Structured sessions only). Verbal approximation of clinician name and initiation of eye contact noted.

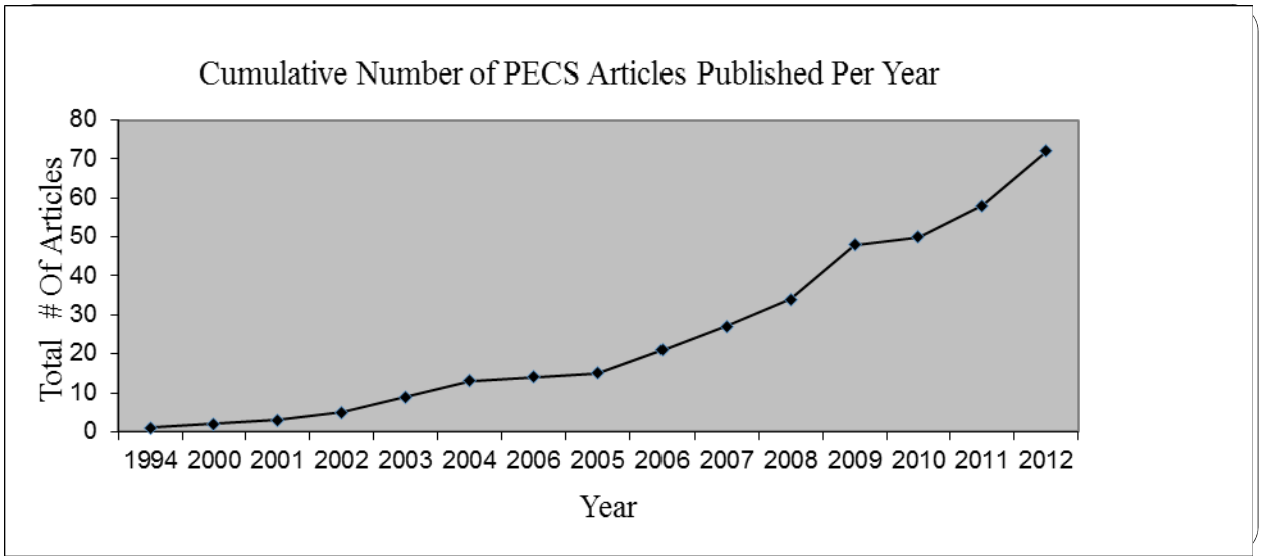
* Studies explicitly evaluating the correlation between maladaptive behavior and PECS use.

Upon review of the nine single-subject design articles, it was determined that only three explicitly addressed the issue of the functional relationship between communication and maladaptive behavior. (Frea, Arnold, & Vittemberga, 2001; Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002; Ganz, Parker, & Benson, 2009). This final set of (nine) studies are summarized in the results section, similar to the descriptive model used by Lancioni, O'Reilly, Cuvo, Singh, Sigafoos, and Didden (2007).

Results

In recent years, there has been a substantial increase in peer-reviewed publications disseminating information regarding the use of PECS (see Figure 1).

Figure 1. Increase in number of PECS articles published per year.



However, as identified by our method, only nine were identified as single-subject design articles. Subsequent sections review the findings of these articles with respect to communication, as well as communication *and* maladaptive behavior.

Effectiveness of PECS for Increase in Communication

While six of the nine single subject articles did not explicitly address the issue of maladaptive behavior in children with ASD (Ganz, & Simpson, 2004; Markel, Neef, & Ferreri, 2006; Angermeier, Schlosser, Luiselli, Harrington, & Carter, 2008; Jurgens, Anderson, & Moore, 2009; Dogoe, Banda, & Lock, 2010; Travis, & Geiger, 2010), they *did* address the subject of increases in effective communication, as follows. Ganz and Simpson (2004) investigated the effectiveness of PECS with respect to increasing functional communication, increasing verbal speech and utterance complexity, and decreasing non-word vocalizations in three individuals with characteristics of autism (aged 3;2-6;0). Each participant had no prior experience with PECS, and was reported to have had limited speech. This study used a single subject (within subjects) design. Independent variables included the experimenter modeling the phrase, "I want ___," and following the PECS training protocol as described by Frost and Bondy (1994). Dependent variables included participant proficiency within each phase of the training protocol (up through Phase IV), number of intelligible words initiated by each participant, and number of non-word vocalizations. All three participants were reported to have made gains on all three dependent variables. That is, they progressed through the PECS protocol to criteria (i.e., 80% accuracy), increased use of intelligible verbal speech (i.e., number of intelligible words), thereby increasing sentence complexity. However, no clear relationship was observed between PECS training and change in non-word vocalizations.

Marckel, Neef, and Ferreri (2006) conducted a single subject design study, as a multiple baseline across descriptors, with two children with ASD between the ages of four and five. The purpose of the study was to investigate the effects of PECS to facilitate problem solving and improvisation. The independent variable was method of stimulus delivery (i.e., "what do you want?") Dependent variables included icons for descriptors (e.g., functions, colors, shapes). During training, participants were explicitly taught to use descriptors when requesting, such as "I want eat white square" for a sandwich (when the icon for "sandwich" was unavailable). Both participants made significant gains in improvisation in the absence of a particular item (i.e., "sandwich").

Angermeier, Schlosser, Luiselli, Harrington and Carter (2008) investigated the impact of iconicity on PECS instruction across Phases I-II. There were four participants ranging in age from six to ten with a diagnosis of ASD, with little to no functional speech, and no prior instruction with graphic symbols. A modified alternating treatment design was implemented, embedded within multiple baseline design across participants. The independent measure was adherence to the PECS training protocol (Frost & Bondy, 1994). Dependent variables were percentage of correct requests per session, as well as number of sessions to criterion (80%). Training was conducted using PECS and Blissymbols, for requesting of highly preferred items (as per preference assessment for each participant). All students achieved mastery for both phases of PECS, suggesting that, for these participants, iconicity was not a factor in mastery of match to sample for purposes of requesting.

Jurgens, Anderson, and Moore (2009) investigated the acquisition of functional communication skills using PECS. In particular, they were concerned with generalization of PECS manding, increases in spoken language, and increases in duration of play. The authors implemented a single subject changing criterion design with their one participant, aged three years seven months. The independent variable was the PECS training protocol up through Phase IV, as delineated by Frost and Bondy (1994). The dependent variables were PECS manding, verbal manding, verbal initiation other than mands, mean length of utterance, and functional play. While increases were observed in the aforementioned dependent variables, generalization of these skills was inconclusive. The authors suggested that this result may have been observed as a function of lack of accessibility to the participant's PECS book during noted opportunities for generalization.

Dogoe, Banda, and Lock (2010) investigated the effects of PECS training on requesting with three preschool aged children with ASD with limited verbal communication skills. More specifically, the authors sought to determine whether acquired skills would generalize across persons (e.g., different communicative partner), settings (e.g., school, community), and stimulus classes (e.g., nouns, verbs). The investigators implemented a multiple baseline across participants design. The independent variable was training using the PECS protocol. The two dependent variables were requesting desired items (as per outcomes of preference assessment), and generalization of requesting. Results indicated both acquisition of requesting skills, and generalization of said requesting, across all three participants.

Travis and Geiger (2010) implemented a multiple baseline across behaviors (i.e., requesting, commenting, and mean length of utterance) for two participants (both aged 9) with ASD. Their objective was to investigate effects of PECS on requesting, development of commenting behavior, and increasing verbal speech. Both participants had no prior exposure to PECS and were reported to have some verbal language. The independent variable was the PECS training (up through Phase VI) (Frost & Bondy, 1994). The dependent variables were frequency of requesting and commenting, as well as mean length of utterance. Results indicated the following: (1) both participants increased requesting using PECS, (2) increases in commenting was observed in both participants, and (3) mean length of utterance increased at the onset of training at Phase IV for both participants.

In summary, of the six aforementioned single-subject design articles, three reported an increase in verbalization, either by way of approximations or complete words (Ganz & Simpson, 2004, Jurgens, Anderson, & Moore, 2009; Travis & Geiger, 2010). Markel, Neef, and Ferreri (2006) uniquely demonstrated an increase in improvised request. Angermeier, Schlosser, Luiselli, Harrington, and Carter (2008) and Dogoe, Banda and Lock (2010) reported mastery of PECS use up to phases II and IIIB, respectively. Results of the remaining three articles, which *did* address the relationship between communication and maladaptive behavior (Frea, Arnold, & Vittemberga, 2001; Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002; Ganz, Parker, & Benson, 2009), are now described in detail.

Effectiveness of PECS for Increase in Communication *and* Decrease in Maladaptive Behavior

Frea, Arnold, and Vittemberga (2001) conducted a multiple baseline design across settings, investigating the use of picture exchange system to communicate basic requesting. They measured the total number of picture exchanges made across settings. One male student, aged four years, was included in their study. The authors found an inverse relationship between use of PECS and aggressive behavior. The investigation was conducted in a general education preschool classroom, during play time, which occurred daily. Particular areas during play time which were most likely to be used by the participant were sand play and puzzles.

Aggressive behavior was defined as biting, kicking, or hitting. A communicative response was defined as the participant handing the picture to someone *while* simultaneously demonstrating a joint attention bid. The participant was observed for 10-minutes, daily, during play time. Two 1-hour teaching sessions (for two consecutive days) were conducted immediately following baseline. During this training, the PECS protocol (Frost & Bondy, 1994) was followed for phases I-III. Intervention sessions immediately followed teaching sessions. These sessions were the same as baseline and treatment, with the addition of the verbal question, “What do you want?”

A multiple baseline across settings design was implemented. Results supported the authors’ hypothesis, in that there was an observed decrease in maladaptive behavior upon implementation of the PECS. This study supported not only the effectiveness of use of the PECS protocol, but (more importantly for this review), the decrease in maladaptive behavior as a function of effective communication.

Charlop-Christy, Carpenter, Le, LeBlanc, and Kellet (2002) empirically assessed the usefulness of PECS. First, the authors assessed the amount of training necessary for mastery of PECS for three children with autism. Second, ancillary gains were assessed, such as pragmatic and behavioral skills. The (primary) dependent variables were spontaneous and imitative verbal speech. The collateral effects on social-communicative functioning and problem behavior were also measured.

Three male students (ages 3;8-12;0) with ASD participated in this study. All three participants were minimally verbal. There were three elements to this study; PECS training, free play, and academic sessions. During the PECS training sessions, all participants engaged in weekly sessions in multiple settings. At first, training occurred at a behavioral afterschool program. Subsequent sessions took place first in the participants' classrooms, and then in their homes. Free play sessions were conducted weekly, prior to, during, and following PECS training. During academic sessions (which occurred with the same frequency as free play sessions), no PECS training materials were used. Rather, task specific materials were present (i.e., flash cards, colored blocks), with traditional objectives appropriate for this population and age group (i.e., color identification and prepositions).

A multiple baseline across participants design was implemented. Dependent variables included speech, social-communicative behavior, and maladaptive behavior across free-play and academic settings. During each free-play or academic session, the experimenter provided five opportunities (each) for spontaneous speech and verbal imitation. To promote spontaneous speech, the experimenter presented the participants with a desired item. To promote verbal imitation, the experimenter presented the participant with the desired item (as in the spontaneous speech elicitation), followed by a modeled word or phrase. More specifically, free play sessions consisted of weekly, 10-minute sessions in which the experimenter would play and speak to the participant. Academic sessions occurred with the same frequency and duration, where the participants were expected to perform tasks included in the regular curriculum. During the actual PECS training, the participants were taught to use PECS twice per week, for 15-minute sessions. Training procedures followed those described by Frost and Bondy (1994).

All three participants mastered the use of PECS with an average training time of 170 minutes. All three participants demonstrated progress in both spontaneous and imitative speech. All participants demonstrated improvement in social-communicative behaviors (i.e., eye contact, joint attention, toy play). Two out of three participants engaged in maladaptive behavior (e.g., grabbing). For these two participants, significant decreases in these behaviors were observed to have changed from baseline to treatment across settings. This finding is significant for the purposes of this review, as it demonstrates the direct correlation between effective communication replacing nonfunctional, maladaptive behavior such as tantrumming.

Ganz, Parker, and Benson (2009) conducted an experiment investigating the impact of PECS on effective communication and maladaptive behaviors in boys with ASD (3;2-6;0). They not only investigated the use of picture exchanges, but also the use of verbal approximations paired with the exchange. Three main research questions were as follows. First, does explicit instruction promote an increase in picture exchange? Second, is there an increase in verbal approximations

(and do these approximations generalize)? Third, do maladaptive behaviors decrease with mastery of PECS use?

Participants were diagnosed with ASD, used infrequent spontaneous verbal speech, and had no prior experience with PECS. All phases of PECS training took place in a small classroom or office. Materials varied across participants according to individualized interests. A multiple baseline probe design was implemented with three dependent variables: 1) picture use, 2) word use, and 3) maladaptive behaviors. Following baseline, experimenters implemented 10-5 minute sessions, instructing participants on the PECS exchange for Phase I, as per the PECS Protocol (Frost & Bondy, 2002).

All participants demonstrated significant increases in picture use during PECS training. Two of the three participants demonstrated significant improvements in use of verbal speech during PECS training, as compared to baseline sessions. Progress regarding maladaptive behaviors, however, was variable. One participant (Ethan) demonstrated few maladaptive behaviors at baseline, but zero by the end of the study. The second participant (Adrian) demonstrated low but variable amounts of maladaptive behaviors throughout the study. The third participant (Jarek), was reported to demonstrate a variable but ascending trend in maladaptive behaviors. The authors explained that their findings may be attributed to the brief duration of PECS intervention, hence not allowing for a substantial duration of observation of a decrease in maladaptive behaviors. (i.e., the decline in behavior may have been more gradual, as opposed sharply declining). A further caveat of the study was that maladaptive behaviors were simply observed, as opposed to targeted, unlike PECS use. In the absence of a functional analysis, one cannot assume that the maladaptive behavior exhibited by the participants were a function of motivation by PECS requesting.

Discussion

As a whole, all nine single subject design articles demonstrated positive outcomes with respect to use of PECS for purposes of communication. Positive gains were reported with regard to verbal speech (three articles), improvisation of requesting using picture exchange (one article), and progress through the hierarchy up through phase IIIB (two articles). Results of this review indicate that only three of the nine articles published using single subject design explicitly addressed the functional relationship between effective communication and maladaptive behavior.

There were a total of seven participants across all three studies investigating the effects of PECS on maladaptive behavior. Of the seven participants across all three studies, four (participants) were observed to decrease instances of maladaptive behavior. It is notable that all seven participants made significant gains in use of PECS. These results can be viewed as positive, in that there appears to be an inverse relationship between use of nonfunctional behavior (i.e., maladaptive behavior) and functional behavior (i.e., use of PECS exchange) for those individuals with ASD who are minimally verbal.

The purpose of this investigation was to evaluate the empirical evidence regarding the change in behavior as a function of PECS use (i.e., use of PECS and maladaptive behaviors using single subject design methods). It appears that, when addressed and observed, there is a (positive)

collateral effect of use of PECS on maladaptive behavior. While case studies have been published on this topic (e.g., Peterson, Bondy, Vincent, & Finnegan, 1995), the lack of an extensive body of literature including well-controlled experimental designs was the impetus for this work. That stated, there appears to be preliminary support for an inverse relationship between the acquisition of PECS use and decrease in maladaptive behavior. However, if all seven out of seven participants across studies had demonstrated significant effects of this relationship, the authors might be able to make more firm conclusions. In addition, this review solidifies the need for further experimental research on the functional relationship between PECS use and maladaptive behavior.

Frea and colleagues (2001) observed an inverse relationship between maladaptive behavior (i.e., biting, hitting, and kicking) and use of PECS exchange. Charlop-Christy and colleagues (2002) supported their conclusions by extending this area of research. Charlop-Christy and colleagues (2002) included three participants in their study; two of whom engaged in maladaptive behaviors (i.e., tantrums, grabbing). For these two participants, there was an observed reduction in maladaptive behavior upon training use of PECS.

Ganz, Parker, and Benson (2009) reported variable performance with respect to reduction in maladaptive behavior. Of note, the authors reported that they did not assess the function of the behaviors observed in their three participants prior to the onset of the study. Had they more clearly isolated the function of these behaviors, Functional Communication Training (FCT) (Carr & Durand, 1985; Tiger, Hanely, & Bruzek, 2008) may have been utilized and monitored as an additional dependent variable. FCT is a teaching strategy which was an outgrowth of the field of applied behavior analysis. The addition of a replacement for a maladaptive behavior for more socially appropriate communicative exchanges is of concern to this paper. There are four primary functions of behaviors: 1) to escape an aversive situation, 2) to gain attention, 3) to obtain a tangible item or activity, and 4) to fulfill a sensory need (Cooper, Heron, & Heward, 2007). If a functional analysis was not conducted, one cannot conclude that the function of the behavior was to obtain a tangible item. If this is the case, then the behavior is not correlated to the use of PECS, potentially explaining why the authors did not observe a behavior change in their third participant.

It is evident from the lack of well controlled single subject design studies (and even more so by the lack of these studies investigating the relationship between communication and maladaptive behavior), that there is a dearth in the literature on the relationship between PECS and maladaptive behavior in individuals with ASD. Speech-language pathologists and special educators working with individuals with ASD will most probably encounter profiles of individuals who will engage in maladaptive behavior, while simultaneously having a limited means to effectively communicate. As such, it is imperative that emerging clinician-scientists add to the body of literature on this topic. In doing so, speech-language pathologists may feel more clinically at ease, knowing that they are engaging in Evidence-Based Practice.

Conclusion

Several considerations should be noted. First, the strength of this study is that it explicitly investigates the relationship between the use of PECS and observation of maladaptive behavior

in a specific clinical population (i.e., autism spectrum disorders). Furthermore, this work summarizes the research to date on PECS use and efficacy of the intervention with students with ASD. Second, the authors here only included studies using single subject research designs. The nature of this literature review was to determine the effect of PECS on maladaptive behavior in individual participants. As single subject research is meant to improve socially significant behavior of the individual participants, it seemed this research design was most applicable to the authors' research question. Third, given the criteria set for this analysis, there were a limited number of studies available for review. Fourth, of the three studies in line with the authors' research question, one did not explicitly assess the function of maladaptive behavior, yielding their findings questionable. However, the findings certainly do not refute this inverse relationship. Fifth, due to the limited number of single subject research articles available, a large-scale meta-analysis was not possible. Should this topic gain momentum in the literature, a more detailed analysis, measuring the breadth and depth of effect sizes, should be conducted to support this descriptive work. Sixth, increasing the breadth and depth of the research published in this area would provide clinicians with guidance on treatment planning for individuals with ASD who are minimally verbal and engage in maladaptive behavior. This is an area that warrants further research to determine the impact of PECS on the maladaptive behavior of individuals with ASD.

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