PYRAMID EDUCATIONAL CONSULTANTS

PECS Related Research

Adkins, T. & Axelrod, S. (2002). Topography-versus selection-based responding: Comparison of mand acquisition in each modality. *The Behavior Analyst Today, 2, 259-266.*
Abstract: This study examined the acquisition of a mand repertoire by one child with pervasive developmental disorder and ADHD. The subject was taught to request preferred items using American Sign Language (a topography-based response form) and the Picture Exchange Communication System (a selection-based form). There were four types of sessions: (1) training session for PECS, (2) training session for sign language, (3) test for generalization of the PECS words, and (4) test for generalization for the sign words. The number of trials to meet criterion and the occurrence of spontaneous emissions of the taught words was recorded. Also, the same word was taught for five days in both the PECS and the sign session and the results were recorded. It was found that the selection-based verbal response technique (PECS) was more effective in all areas. This finding contradicts the results of previous studies, suggesting that further research is needed. (http://www.behavior-analyst-online.org)

Agius, M. & Vance, M. (2015). A comparison of PECS and iPad to teach requesting to pre-schoolers with autistic spectrum disorders. *Augmentative and Alternative Communication, Nov 20, 1-11.*
Abstract: Few studies have compared the efficacy of the Picture Exchange Communication System (PECS) and iPads used as speech generating devices (SGDs), and none have targeted preschoolers. This study compares the relative efficacy of PECS and an iPad/SGD with three preschool-aged children with autism spectrum disorder and limited functional speech who lived in Malta. The study utilized an adapted alternating treatment design embedded in a multiple baseline design, with requesting of reinforcers as the dependent variable. Visual analysis of the results indicated that all participants required more prompted trials and sessions for the iPad/SGD condition. All participants learned a three-step navigational sequence on the iPad. Participant preference probes were inconclusive and were not linked to speed of acquisition of requesting skills. Results suggest that both PECS and an iPad could be appropriate for teaching requesting skills to beginning communicators.

Almeida, M., Piza, M., & LaMonica, D. (2005). Adaptation of the picture exchange communication system in a school context (original title: Adaptações do sistema de comunicação por troca de figuras no contexto escolar) *Pró-Fono Revista de Atualização Científica, Barueri (Spanish), 17, 233-240.*
Abstract: Background: alternative communication. Aim: to evaluate the efficacy of the adapted PECS and Picture Communication Symbols (PCS) in the communication of a child with cerebral palsy. Method: the participant of this study was a 9 year and 10 months old girl, with athetoid quadriplegia. All stages of the adapted Pecs were applied (Walter, 2000), using the PCS pictures (Johnson, 1998), associated with the functional curriculum proposed by LeBlanc (1991). An experimental AB Design was used in order to test the procedures. Results: the subject was able to pass through all of the adapted Pecs phases and to use her communication board in school

activities. Conclusion: the adapted Pecs proved to be effective in improving the subject's communication abilities.

Alsayedhassan, B., Banda, D. & Griffin-Shirley, N. (2020). Training parents of children with autism to implement the picture exchange communication intervention. *Clinical Archives of Communication Disorders, 5*, 31-41.
Abstract: Background: Autism spectrum disorder impacts social communication. Picture Exchange Communication System is one of the methods to improve communication skills in individuals with autism. In spite of numerous studies on the effectiveness of Picture Exchange Communication System, no studies were conducted to examine the perceptions of practitioners who used the strategy. Method: An online survey was conducted with 120 practitioners (44 teachers and 76 therapists; 80.8% 20–49 years old; 80.8% graduate education) who used the Picture Exchange Communication System with children with autism. Using rating scales, practitioners reported their knowledge of Picture Exchange Communication System and their perceptions about importance, benefits, and barriers of utilizing Picture Exchange Communication System.
Results: Practitioners reported they were confident when implementing Picture Exchange Communication System and considered integrating Picture Exchange Communication System at school to be important. Also, the practitioners indicated that Picture Exchange Communication System was easy to use and effective to develop communication skills in children with autism. However, they found that using Picture Exchange Communication System was time consuming. Conclusion: It is important to hear the viewpoints of practitioners concerning the use of Picture Exchange Communication System for individuals with autism spectrum disorder. This study found Picture Exchange Communication System is a useful strategy but has some barriers concerning its use. Future research is needed to confirm the current findings with a larger sample.

Alsayedhassan, B., Lee, J., Banda, D. Kim, K. & Griffin-Shirley, N. (2019): Practitioners' perceptions of the picture exchange communication system for children with autism. *Journal of Disability and Rehabilitation*, *41*.**https://DOI:10.1080/09638288.2019.1620878.**
Abstract: **Purpose**: We investigated the effects of behavioral skills training package with parents to use picture exchange communication system (PECS) with their children with autism spectrum disorder (ASD) to develop communication skills. **Methods**: Two parents and their children with ASD (one child per family) participated in this study. A multiple baseline design was used during the parents' training, and a changing criterion design was used during parents' implementation of PECS with children. **Results**: Results indicated that both parents implemented PECS intervention with their children with high procedural integrity and required minimal feedback through Bug-in-Ear at the end of the intervention. Moreover, both children acquired independent picture exchanges with their parents who implemented PECS training and generalized and maintained the skills. **Conclusions**: The findings suggest that when parents receive appropriate training and feed-back, they can train their children to use PECS to independently request desired items or activities. The current study extends existing research

on PECS by teaching parents as the primary PECS trainers to implement the strategy with their children.

Alzrayer, N. (2020). Transitioning from a low- to high-tech Augmentative and Alternative Communication (AAC) system: effects on augmented and vocal requesting. *Augmentative and Alternative Communication*, https://doi.org/10.1080/07434618.2020.1813196.
ABSTRACT: A considerable number of studies have demonstrated that augmentative and alternative communication (AAC) is effective in increasing speech production in some children with autism spectrum disorder (ASD). Thus, this study aimed to (a) investigate the effects of a Picture Exchange Communication System (PECS) Phase IV protocol on the acquisition of spontaneous augmented requests, (b) evaluate the impact of progressive time delay and synthetic speech output on the development of vocal requests, and (c) determine the participants' preferences for each modality after reaching mastery. A multiple-baseline design across four children with ASD was used to measure the acquisition of augmented and vocal requests during the transition from low-tech to high-tech AAC systems. During a natural condition (i.e., playtime), a modified PECS Phase IV protocol was applied to teach the participants to request by producing multisymbol messages (e.g., I WANT þ names of a preferred item) using an iPad as well as vocalizations. After mastery, the participants' preference for using the modified PECS Phase IV app or the communication book was assessed by comparing the response allocations. The preliminary results suggest that the modified PECS protocol can be used to transition from a low to high-tech communication modality.

Anderson, A., Moore, D. & Bourne, T. (2007). Functional Communication and Other Concomitant Behavior Change Following PECS Training: A Case Study. *Behaviour Change, 24, 1–8.*
Abstract: The Picture Exchange Communication System (PECS) is widely used to teach children with language delays, including those with autism, functional language. A feature of PECS is that it incorporates principles deemed by some to be pivotal, leading to broader behaviour change. In this study, a 6-year-old child with autism was taught functional language using PECS. Along with measures of language gains, concomitant changes in nontargeted behaviours (play and TV viewing) following PECS training were observed. Results show increases in manding, initiations and cumulative word counts, as well as positive changes in the nontargeted behaviours.

Angermeier, A., Schlosser, R., Luiselli, J., Harrington, C., & Carter, B., (2008). Effects of iconicity on requesting with the Picture Exchange Communication System in children with autism spectrum disorder. *Research in Autism Spectrum Disorders, 2, 430–446.*
Abstract: Research on graphic symbol learning suggests that symbols with a greater visual resemblance to their referents (greater iconicity) are more easily learned. The iconicity hypothesis has not yet been explored within the intervention protocol of the Picture Exchange Communication System (PECS). Within the PECS protocol, participants do not point to a symbol but exchange the symbol for an object. The purpose of this study was to examine whether children learn to request more readily with PECS when the symbols involved are highly iconic versus symbols that are low in iconicity. An adapted alternating treatments design combined

with a multiple baseline design across subjects was used to evaluate the effectiveness and efficiency of symbol learning under two conditions: high iconicity and low iconicity. Four students with autism or pervasive developmental disorders between the ages of six and nine years participated. Results indicated that students learned to request desired objects under both conditions, lending further support for the effectiveness of PECS. There was little to no difference, however, in the effectiveness and efficiency of requesting between the two conditions during Phases I and II of PECS training. Thus learners do not benefit from symbols that bear more resemblance with their referents during the first two phases of PECS instruction.

Avagyan, A. (2019). Picture Exchange Communication System (PECS) as a connected speech development tool for children from immigrant families in Armenia *The Journal of the International Association of Special Education, 19*, 37-44.
Abstract: Alternative methods of communication skill development, such as Picture Exchange Communication System (PECS), are often used in speech therapy. PECS has been widely used for communication development in children with autism and has proven its efficacy in a large number of studies. PECS is used with people displaying a variety of communication disorders. A review of the literature over the past decade revealed little systematic activity to document or improve PECS intervention services for bilingual children. This study evaluates the effects of PECS intervention with bilingual children from immigrant families in Armenia. PECS could serve as an alternative tool to improve connected speech in bilingual children from immigrant families, thus enhancing their socialization. The study was conducted with nine Armenian children for whom Arabic or Russian was a native language, and Armenian was a second language. These children did not have a good command of the Armenian

Barbosa, R., de Oliveira, A., de Lima Antão, J., Crocetta, T., Guarnieri, R., Antunes, T., Arab, C., Massetti, T., Bezerra, I., de Mello Monteiro, C. & de Abreu, L. (2018). Augmentative and alternative communication in children with Down's syndrome: a systematic review. *BMC Pediatrics, 11*, doi: 10.1186/s12887-018-1144-5.
Abstract: Background: The use of technology to assist in the communication, socialization, language, and motor skills of children with Down's syndrome (DS) is required. The aim of this study was to analyse research findings regarding the different instruments of 'augmentative and alternative communication' used in children with Down's syndrome. **Methods:** This is a systematic review of published articles available on PubMed, Web of Science, PsycInfo, and BVS using the following descriptors: assistive technology AND syndrome, assistive technology AND down syndrome, down syndrome AND augmentative and alternative communication. Studies published in English were selected if they met the following inclusion criteria: (1) study of children with a diagnosis of DS, and (2) assistive technology and/or augmentative and alternative communication analysis in this population. **Results:** A total of 1087 articles were identified. Thirteen articles met the inclusion criteria. The instruments most used by the studies were speech-generating devices (SGDs) and the Picture Exchange Communication System (PECS). **Conclusion:** Twelve instruments that provided significant aid to the process of

communication and socialization of children with DS were identified. These instruments increase the interaction between individuals among this population and their peers, contributing to their quality of life and self-esteem.

Barlow, K., Tiger, J., Slocum, S. & Miller, S. (2013). Comparing acquisition of exchange-based and signed mands with children with autism. *The Analysis of Verbal Behavior, 29, 59-69.*
Abstract: Therapists and educators frequently teach alternative-communication systems, such as picture exchanges or manual signs, to individuals with developmental disabilities who present with expressive language deficits. Michael (1985) recommended a taxonomy for alternative communication systems that differentiated between selection-based systems in which each response is topographically identical (e.g., card selection and exchange systems) and topography-based systems in which each response is topographically distinct (e.g., signed language). We compared the efficiency of training picture exchanges and signs with 3 participants who presented with severe language deficits; all participants acquired the picture-exchange responses more readily.

Barnes, C., Dunning, J. & Rehfeldt, R.A. (2011). An evaluation of strategies for training staff to implement the picture exchange communication system. *Research in Autism Spectrum Disorders, 5, 1574–1583.*
Abstract: The picture exchange communication system (PECS) is a functional communication system frequently used with individuals diagnosed with autism spectrum disorders who experience severe language delays (Frost & Bondy, 2002). Few empirical investigations have evaluated strategies for training direct care staff how to effectively implement PECS with clients. Using a multiple probe design, the current investigation evaluated staff training procedures for teaching three direct care staff to implement phases 1–3 of PECS for 3 adults with autism. Training with verbal instructions and an instructional video resulted in little improvement from pretest scores, underscoring the limited utility of workshops and instructional videos alone in teaching paraprofessional staff important clinical skills.

Battaglia, D. & McDonald, M. (2015). Effects of the Picture Exchange Communication System (PECS) on maladaptive behavior in children with Autism Spectrum Disorders (ASD): A Review of the Literature. *Journal of the American Academy of Special Education Professionals, Winter, 8-20.*
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.

Bazain, D. & Bari, S. (2017). Communicating by using PECS for Children with Rubinstein-Taybi Syndrome. *Journal of Research and Development of Extraordinary Education, 4,* 29-31. (Malaysia)
Abstract: This study discusses communication aid using the Picture Exchange Communication System (PECS) to children with Rubinstein Taybi Syndrome (RTS). RTS's children suffer mental retardation, have the – the autistic, can not speak and can not manage themselves well. The aim of this study was to determine the effectiveness of using PECS and RTS students can improve their language to communicate better to all. Based on the theory of constructivism introduced by Gagne that emphasizes learning system must start from the simple to the complex. The study design is a case study of a child suffering from Rubinstein-Taybi syndrome. In conclusion, the PECS implemented is expected can help children's RTS and improve their academic performance.

Beck, A., Stoner, J., & Bock, S. (2008) Comparison of PECS and the use of a VOCA: A Replication. *Education and Training in Developmental Disabilities, 43 (2), 198-216.*
Abstract: This study compares use of the Picture Exchange Communication System (PECS) and a Voice Output Communication Aide (VOCA) with four preschool children who were either nonspeaking or limited in their ability to speak and did not use an AAC system to communicate functionally. An alternating treatment single subject design was used to measure participants' preferences for each system and the verbalizations of the participants during system use. Results indicated that participants learned PECS in a relatively short time period, preferences for one mode of communication are not predictable, and the influence of the communication systems on each participant's verbalizations varied.

Bock, S.J., Stoner, J. B., Beck, A. R., Hanley, L., & Prochnow, J. (2005). Increasing functional communication in non-speaking preschool children: Comparison of PECS and VOCA. *Education and Training in Developmental Disabilities, 40(3), 264-278.*
Abstract: Education and Training in Developmental Disabilities, 40(3), 264-278.o have complex communication needs and for the interventionists who work with them, the collection of empirically derived data that support the use of an intervention approach is critical. The purposes of this study were to continue building an empirically derived base of support for, and to compare the relative effectiveness of two communication intervention strategies (i.e., PECS and the use of VOCA) with preschool children who have complex communication needs. Specific research questions were (a) Which communication strategy, PECS or VOCA, results in a more rapid rate of acquisition of requesting skills for preschool children?, and (b) To what extent do communication behaviors utilizing PECS and VOCA generalize from a pull-out setting to the classroom setting? Results are discussed and clinical implications given.

Boesch, M., Wendt, O., Subramanian, A. & Hsu, N. (2013). Comparative efficacy of the Picture Exchange Communication System (PECS) versus a speech-generating device: Effects on requesting. *Research in Autism Spectrum Disorders, 7, 480-493.*
Abstract: An experimental, single-subject research study investigated the comparative efficacy

of the Picture Exchange Communication System (PECS) versus a speech-generating device (SGD) in developing requesting skills for three elementary-age children with severe autism and little to no functional speech. Results demonstrated increases in requesting behavior for all participants across intervention phases with both augmentative and alternative communication (AAC) intervention strategies; however, difficulties were observed with picture discrimination. The Wilcoxon signed pair test did not reveal significant differences between PECS and the SGD for any participant. Findings suggest PECS and SGD are equally appropriate for developing initial requesting skills. Based on the current findings, successful implementation of either AAC strategy is achievable when appropriate instructional strategies are used.

Bondy, A. & Battaglini, K. (2006). Application of the Pyramid Approach to Education Model in a Public-School Setting. *In J. Handleman & S. Harris (Ed.) School-age education programs for children with autism (pp. 163-193). Austin: TX. Pro-Ed Inc.*

Bondy, A. & Battaglini, K. (2007). Application of the Pyramid Approach to Education Model in a Preschool School Setting. *In J. Handleman & S. Harris (Ed.) Pre-school education programs for children with autism 3rd Edition). (pp. 283-308). Austin: TX. Pro-Ed Inc.*

Bondy, A. & Frost, L. (1998). The picture exchange communication system. *Seminars in Speech and Language, 19, 373–389.*
Abstract: The Picture Exchange Communication System (PECS) was developed as a means to teach children with autism and related developmental disabilities a rapidly acquired, self-initiating, functional communication system. Its theoretical roots combine principles from applied behavior analysis and guidelines established within the field of alternative and augmentative communication. This approach has several potential advantages relative to imitation-based strategies (both vocal and gestural) and symbol selection strategies. The system begins with the exchange of simple icons but rapidly builds “sentence” structure. The system also emphasizes developing the request function prior to developing responding to simple questions and commenting. The development of requesting with a sentence structure also permits the rapid development of attributes more traditionally taught within a receptive mode. The relationship between the introduction of PECS and various other behavioral issues (i.e., social approach and behavior management) as well as its relationship to the co-development of speech are reviewed.

Bondy, A. & Frost, L. (2001). The Picture Exchange Communication System. *Behavior Modification, 25, 725-744.*
Abstract: The Picture Exchange Communication System (PECS) is an alternative/augmentative communication system that was developed to teach functional communication to children with limited speech. The approach is unique in that it teaches children to initiate communicative interactions within a social framework. This article describes the advantages to implementing PECS over traditional approaches. The PECS training protocol is described wherein children are taught to exchange a single picture for a desired item and eventually to construct picture-based

sentences and use a variety of attributes in their requests. The relationship of PECS's implementation to the development of speech in previously non-vocal students is reviewed. (http://www.sagepub.com)

Bondy, A. & Frost, L. (2003). Communication strategies for visual learners. *In O.I. Lovaas (Ed.). Teaching Individuals with Developmental Disabilities: Basic Intervention Techniques (pp. 291-303). Austin, TX: Pro-Ed. [Book chapter].*

Bondy, A. & Frost, L. (2008). Autism 24/7: A Family Guide to Learning at Home and in the Community. *Baltimore, MD: Woodbine House.*

Bondy, A. & Frost, L. (2009). Generalization Issues Pertaining to the Picture Exchange Communication System (PECS). In C. Whalen (Ed.) Real Life, Real Progress for Children with Autism Spectrum Disorders: Strategies for Successful Generalization in Natural Environments. *Baltimore, MD: Paul Brookes Publishing Company.*

Bondy, A. & Frost, L. (2009). The Picture Exchange Communication System: Clinical and Research Applications. In P. Mirenda & T. Iacono (Eds.) Autism Spectrum Disorders and AAC. *Baltimore, MD: Paul Brookes Publishing Company. Pp. 279-302.*

Bondy, A. (2001). PECS: Potential benefits and risks. *The Behavior Analyst Today, 2, 127– 132.*
Abstract: The Picture Exchange Communication System (PECS) is an augmentative/alternative communication strategy for those who display little or no speech. The rationale for PECS and its training sequence is described. Each phase of training is associated with specific behavior analytic teaching strategies. Skinner's analysis of Verbal Behavior forms the basis for teaching particular skills at specific points in the training sequence and also provide guidelines for how best to design the teaching strategies. Common problems and potential solutions are offered for various levels of training. The relationship between PECS and the co-development of speech, as well as its impact upon other behaviors (e.g., behavior management concerns, social orientation, etc.) is briefly reviewed.

Bondy, A. (2012). The unusual suspects: Myths and misconceptions associated with PECS. *The Psychological Record, 62, 789-816.*
Abstract: The Picture Exchange Communication System (PECS) is an alternative/augmentative communication protocol designed to help children and adults with autism and related disabilities to engage in functional communication. The protocol was developed over a number of years and was based on Skinner's analysis of verbal behavior. Publications about the application and effectiveness of PECS have grown steadily. However, there also are many misconceptions about the protocol and its implementation. This paper reviews some of the research associated with PECS, describes several myths and misconceptions, and attempts to clarify many of the issues raised.

Bondy, A. (2019). Issues related to AAC and SGD use by adolescents and adults with Autism Spectrum Disorder. *Advances in Neurodevelopmental Disorders, 3,* 351-362.
Abstract: The use of technology, especially speech-generating devices (SGDs), has generated a great deal of attention. In order to assess the quality and effectiveness of such strategies, many issues related to terminology and teaching require careful attention. The first section begins with a discussion about functional communication, including long-term goals, from a behavioral perspective. Key issues will include speaker vs. listener distinctions, functional units, and factors related to expanding communication repertoires. The next section reviews SGDs, their popularity, and concerns such as distinguishing between *toy use* vs. *communication device* and the role of the audio output. Next, factors related to demonstrations that a user *knows* the meaning of words in different modalities will be considered. There follows a look at some research examples related to both SGD and picture use by adolescents and adults with ASD regarding functional communication. This section includes examples of studies that appear to have overestimated functional outcomes as well as noting the overall paucity of research demonstrating a robust gain in repertoire size and complexity. Lastly, suggestions are offered associated with determining how clinicians can assure that efforts to teach functional communication to individual teenagers and adults will result in effective outcomes.

Bondy, A., & Frost, L. (1993). Mands across the water: A report on the application of the picture exchange communication system in Peru. *The Behavior Analyst, 16, 123–128.*
Abstract: This report describes the introduction of the Picture-Exchange Communication System (PECS) to the Ann Sullivan Center, a program for developmentally disabled children and adults in Lima, Peru. PECS was developed in the Delaware Autistic Program, a public school program in the United States with a strong behavior-analytic orientation for children with autism. We will briefly describe PECS, its advantages with people with language disabilities, and our efforts to work with the staff of the Ann Sullivan Center to implement the system. (http://www.abainternational.org)

Bondy, A., & Frost, L. (1994). The picture exchange communication system. *Focus on Autistic Behavior, 9, 1–19.*
Abstract: A variety of strategies have been used to help children with autism acquire functional communication skills. The Picture Exchange Communication System (PECS) is a unique communication training program that was developed as a means of circumventing some shortcomings associated with these strategies. A description of the steps within PECS is provided. Long-term group data have indicated that a large proportion of children started on PECS as preschoolers acquire speech. Individual and group data supporting the use of PECS are provided. (http://www.proedinc.com)

Bondy, A., & Frost, L. A. (1993). Mands across the water: A report on the application of the picture exchange communication system in Peru. *The Behavior Analyst, 16, 123–128.*
Abstract: This report describes the introduction of the Picture-Exchange Communication System (PECS) to the Ann Sullivan Center, a program for developmentally disabled children and

adults in Lima, Peru. PECS was developed in the Delaware Autistic Program, a public school program in the United States with a strong behavior-analytic orientation for children with autism. We will briefly describe PECS, its advantages with people with language disabilities, and our efforts to work with the staff of the Ann Sullivan Center to implement the system. (http://www.abainternational.org)

Bondy, A., Esch, B., Esch, J. & Sundberg, M. (2010). Questions on Verbal Behavior and its application to individuals with autism: An interview with the experts. *The Behavior Analyst Today, 11, 186-205.*
Abstract: A note about the interviews from the editors: The use of Skinner's Verbal Behavior (VB) classification system has been increasingly applied to learners with autism. We asked several of the best known behavior analysts to answer some key questions regarding this practice, the state of research regarding the advantages of this approach, and the confusion that exists regarding the application of VB to this population of learners. We structured the responses to follow each question separately, indicating the responder in each case. At the end of the interviews, you will find relevant references from each responder. (http://www.baojournal.com/BAT%20Journal/VOL-11/BAT%2011-3.pdf)

Bondy, A., Horton, C. & Frost, L. (2020). Promoting functional communication within the home. *Behavior Analysis in Practice* ***https://doi.org/10.1007/s40617-020-00439-6***
Abstract: Functional communication skills are essential for all learners and must be promoted within all environments, including the home. During this time of home confinement, many families will need to look at opportunities for their children to use existing functional communication skills or even to acquire new skills. This article describes a set of 9 critical communication skills and provides a variety of examples of how families can improve the use of these important skills. Some of these involve speaker (expressive) skills, whereas others involve listener (receptive) skills.

Bondy, A., Tincani, M. & Frost, L. (2004). Multiply controlled verbal operants: An analysis and extension to the Picture Exchange Communication System. *The Behavior Analyst, 27,247-261.*
Abstract: This paper presents Skinner's (1957) analysis of verbal behavior as a framework for understanding language acquisition in children with autism. We describe Skinner's analysis of pure and impure verbal operants and illustrate how this analysis may be applied to designing communication training programs. The Picture Exchange Communication System (PECS) is a training program influenced by Skinner's framework. We describe the training sequence associated with PECS and illustrate how this sequence may establish multiply controlled verbal behavior in children with autism. We conclude with an examination of how Skinner's framework may apply to other communication modalities and training strategies. (http://www.abainternational.org)

Bridge, D. & Carter, S. (2007). A personal account of using the Picture Exchange Communication System (PECS) with a child with autism. *In J. Sigafoos & V. Green (Eds.) Teaching and Technology, pp. 183-193. Nova Science Publishers, Tasmania.*
Abstract: This chapter describes the use of the Picture Exchange Communication System (PECSTM) (Frost & Bondy, 2002) with a child with autism. It explains the PECS system and offers some examples of how this communication technology was used with the child (Thomas), his parents and teachers in his early learning at home and in his classroom. Through this case some of the strengths of this technology are identified, and Thomas' experiences are linked to research in the area. Some issues related to using such a program are considered.

Busch, L., Koudys, J. (2017). Evidence-based practices for individuals with autism spectrum disorder: Recommendations for caregivers, practitioners, and policy makers. *Resource document. Ontario Association for Behavior Analysis.* ***https://www.ontaba.org/pdf/ONTABA OSETT-ASD REPORT WEB.pdf***

Cagliani, R., Ayres, K., Whiteside, E. & Ringdahl, J. (2017). Picture Exchange Communication System and Delay to Reinforcement. *Journal of Developmental and Physical Disabilities, 29* ,925-939.
Abstract: Picture Exchange Communication Systems (PECS) is a form of augmentative and alternative communication (AAC) frequently used by individuals with autism spectrum disorder and intellectual disability when speech development is delayed or does not develop (Bondy and Frost 1994 in *Focus on Autism and Other Developmental Disabilities, 9*, 1–19; Sunberg and Partington 1998). Researchers have previously evaluated variations of PECS as a means for vocalization development (Ganz and Simpson 2004 in *Journal of Autism and Developmental Disorders, 34*, 395–409; Tincani et al. 2006 in *Education and Training in Developmental Disabilities, 41*, 177–184). The current study investigated delay to reinforcement and an increase in response effort when utilizing PECS on the development of intelligible word vocalizations with four elementary aged students. Three participants transitioned from primarily requesting using PECS at Phase IIIb to using independent vocalizations (i.e., spoken words). This research provides further evidence for the use of PECS not only as a tool for functional communication, but also as a resource for assisting individuals in the development of vocalizations with slight variations in the parameters of reinforcement including response effort and delay of reinforcement.

Campos de Jesus, J., Oliveria, T. & Vieira de Rezende, J. (2017). Generalization of Mands Learned by PECS (Picture Exchange Communication System) in Children with Autism. *Trends in Psychology / Temas em, 25,* 531-543. (Brazil)
Abstract: Verbal training with the use of alternative communication is a tool for improving the social interaction of children with Autism Spectrum Disorder (TEA). The aim of this study was to promote generalization of trained mands through the Picture Exchange Communication System (PECS). Trained mands comprise the exchange of pictures with visual stimuli by the items themselves. There were 4 autists aged between 6 and 12 years old, who took part in the study.

After the PECS training, the teacher and the mothers were instructed to take notes of the mands performed in school and home settings. Results have shown that 3 children met the learning criterion for PECS and that there was a generalization for other settings. The need for greater control of the variables that interfere with mand acquisitions and the children planning for generalization of environment, people and different items have been discussed.

Cannella-Malone, H., Fant, J., & Tullis, C. (2010). Using the Picture Exchange Communication System to Increase the Social Communication of Two Individuals with Severe Developmental Disabilities. *Journal of Developmental and Physical Disabilities, 22, 149-163.*
Abstract: The purpose of this study was to examine the effectiveness of the PECS with Peers protocol developed by Garfinkle and Schwartz (1994), which uses The Picture Exchange Communication System (PECS) as a means of increasing social communication between individuals with disabilities and their peers. Two females with severe communication delays and developmental disabilities served as participants and one male with developmental disabilities and one female without disabilities acted as their peers. A multiple baseline across behaviors (i.e., greetings, requests, and responses) design was used to assess the effectiveness of PECS on social communication as well as to examine whether using PECS led to increases in the participants' verbal communication. Both participants increased their social interactions using PECS with their peer and also demonstrated a general preference for verbal communication. Social validity questionnaires indicated that teachers and parents found the social communication skills to be important and that this intervention was helpful.

Carr, D. & Felce, J. (2006). Increase in production of spoken words in some children with autism after PECS teaching to Phase III. *Journal of Autism and Developmental Disabilities, 37. 780-787.*
Abstract: The context for this work was an evaluation study (Carr & Felce, under review) of the early phases of the Picture Exchange Communication System [PECS] (Frost & Bondy, 1994; 2002). This paper reports that 5 of 24 children who received 15 hours of PECS teaching towards Phase III over a period of 4-5 weeks, showed concomitant increases in speech production, either in initiating communication with staff or in responding, or both. No children in the PECS group demonstrated a decrease in spoken words after receiving PECS teaching. In the control group, only 1 of 17 children demonstrated a minimal increase and 4 of 17 children demonstrated a decrease in use of spoken words after a similar period without PECS teaching.

Carr, D. & Felce, J. (2007). The effects PECS teaching to Phase III on the communicative interactions between children with autism and their teachers. *Journal of Autism and Developmental Disabilities, 37, 724-737.*
Abstract: The study investigated the impact of mastery of the Picture Exchange Communication System (PECS) to Phase III, on the communications of children with autism. Children aged between 3 and 7 years, formed a PECS intervention group and a non-intervention control group. The intervention group received 15 h of PECS teaching over 5 weeks. Three 2-h classroom observations recorded communications between the children and their teachers. These occurred: 6 weeks before teaching; during the week immediately prior to teaching;

during the week immediately following teaching. For the control group, two 2-h observations were separated by a 5-week interval without PECS teaching. Communicative initiations and dyadic interactions increased significantly between the children and teachers in the PECS group but not for the control group.

Carre A., Le Grice, B., Blampied, N., & Walker, D. (2009). Picture Exchange Communication (PECS) Training for young children: Does training transfer to school and to home? *Behaviour Change, 26, 54-65.*
Abstract: The limited communicative abilities of young children with autism and developmental disabilities may be enhanced by augmentative communication systems such as the Picture Exchange Communication System (PECS). Both children and adults can learn to use PECS, but research is inconsistent in establishing the degree to which PECS training transfers reliably from the training setting to other settings, for example, regular classrooms, and home. Three 5–6-year-old children, diagnosed as autistic and/or developmentally disabled, were given 1:1 PECS training at school, structured to enhance generalisation and transfer. Concurrent observations were made in their regular classroom and at home to probe the extent of generalisation. All three acquired the ability to request a preferred object or activity by exchanging a picture symbol with a communicative partner. In tests of transfer and generalisation, a multiple-baseline across subjects design showed no use of PECS symbols either in the classroom or at home prior to training, with spontaneous initiations of picture exchange (transfer) occurring to a slight to moderate degree in the classroom and to a slight degree at home. Even with PECS training structured to enhance transfer, functionally significant degrees of generalisation of training may be difficult to achieve and cannot be assumed to occur.

Carson, L., Moosa, T., Theruer, J. & Cardy, J.O. (2012). The Collateral Effects of PECS Training on Speech Development in Children with Autism. *Canadian Journal of Speech-Language Pathology and Audiology, 36, 182-195.*
Abstract: Research suggests that 25 to 61% of children with autism will use little or no functional speech to communicate. For these children, many speech-language pathologists will teach the use of the Picture Exchange Communication System (PECS). Studies have reported some children go on to develop functional speech after using PECS. What remains unclear is (i) which children will begin to use functional verbal abilities, and (ii) why this occurs for some and not others. The purposes of this study were to: (a) measure changes in speech production in children with autism after PECS use, and (b) explore whether these changes could be related to children's pre-intervention characteristics, including adaptive functioning, symbolic representation, motor imitation and receptive and expressive language skills. Three male children with autism spectrum disorder aged 2–3 years participated in this study, which followed a single-subject, changing-criterion design. At study outset, speech skills and pre-intervention characteristics were assessed. Parents were then trained to use PECS with their child during weekly clinic and home visits across a five-month period. Speech production data were collected during monthly probes and at post-intervention, then analyzed and compared to pre-intervention characteristics. Results showed changes to speech occurred for Participants 1

and 3. Comparison of pre-intervention characteristics revealed imitation as the only skill area that was different between children, with Participant 3 demonstrating higher motor and verbal imitation scores. These preliminary results suggest that stronger imitation skills may increase the likelihood that a child with autism will develop functional speech after PECS use.

Chaabane, D.Ben , Alber-Morgan, S., & DeBar, R. (2009). The effects of parent-implemented PECS training on improvisation of mands by children with autism. *Journal of Applied Behavior Analysis, 42, 671-677.*
Abstract: The present study examined the extent to which mothers were able to train their children, 2 boys with autism, to exchange novel pictures to request items using the picture exchange communication system (PECS). Generalization probes assessing each child's ability to mand for untrained items were conducted throughout conditions. Using a multiple baseline design, results demonstrated that both children improvised by using alternative symbols when the corresponding symbol was unavailable across all symbol categories (colors, shapes, and functions) and that parents can teach their children to use novel pictorial response forms.

Chambers, M. & Rehfeldt, R. (2003). Assessing the acquisition and generalization of two mand forms with adults with severe developmental disabilities. *Research in Developmental Disabilities, 24, 265-280.*
Abstract: The purpose of this study was to determine whether manual sign or the Picture Exchange Communication System (P.E.C.S.) (Frost and Bondy, 1994) would be more effective in teaching mand skills to adults with mental retardation in the severe and profound range. Four participants were taught to mand for four reinforcing items using both communication modalities, in an alternating treatments design. Three of four participants demonstrated criterion performance across all four mands using P.E.C.S. first. Two of those three participants later demonstrated criterion performance for the mands using manual sign. The fourth participant was removed from the study during training due to illness, but her progress indicated greater acquisition with P.E.C.S. Generalization probes conducted at participants' respective residences showed that three participants demonstrated generalization across settings using P.E.C.S., and two participants demonstrated generalization across settings using manual sign. Participants were also more likely to mand for reinforcing items not present using P.E.C.S. than using manual sign. (www.sciencedirect.com/science/journal/08914222)

Charlop, M., Malmberg, D., & Berquist, K. (2008). An application of the Picture Exchange Communication System (PECS) with children with autism and a visually impaired therapist. *Journal of Developmental and Physical Disabilities, 19, 509-515.*
Abstract: The Picture Exchange Communication System (PECS) (Bondy and Frost, Focus on Autistic Behavior 9:1–19, 1994) is a visually-based alternative and augmentative communication system that is considered appropriate for many special populations. However, a variety of challenged populations, such as people with visual impairments, would initially be considered unable to communicate with PECS users. In the present study, a multiple baseline reversal design across children was used to explore the viability of a Braille-modified PECS

system for use between a visually impaired therapist and three children with autism. The PECS cards were slightly modified with the addition of Braille labels so that the visually impaired therapist would be able to understand and respond to the requests of the children with autism. Results indicated that the addition of Braille labels allowed children with autism and the visually impaired therapist to communicate with each other using PECS. In addition, children had ancillary decreases in problem behaviors during work sessions with the Braille-modified PECS. This study demonstrated the versatility of PECS and its potential for use with non-sighted populations, increasing opportunities of visually impaired persons in the job market.

Charlop-Christy, M.H., Carpenter, M, Le, L., LeBlanc, L, & Kelley, K. (2002). Using the Picture Exchange Communication System (PECS) with children with autism: Assessment of PECS acquisition, speech, social-communicative behavior, and problem behaviors.
Journal of Applied Behavior Analysis, 35, 213-231.
Abstract: The picture exchange communication system (PECS) is an augmentative communication system frequently used with children with autism (Bondy & Frost, 1994; Siegel, 2000; Yamall, 2000). Despite its common clinical use, no well-controlled empirical investigations have been conducted to test the effectiveness of PECS. Using a multiple baseline design, the present study examined the acquisition of PECS with 3 children with autism. In addition, the study examined the effects of PECS training on the emergence of speech in play and academic settings. Ancillary measures of social-communicative behaviors and problem behaviors were recorded. Results indicated that all 3 children met the learning criterion for PECS and showed concomitant increases in verbal speech. Ancillary gains were associated with increases in social-communicative behaviors and decreases in problem behaviors. The results are discussed in terms of the provision of empirical support for PECS as well as the concomitant positive side effects of its use.

Chua, B. & Poon, K. (2018). Studying the implementation of PECS in a naturalistic special education school setting. *Education and Child Psychology*, 35, 60-75.
Abstract: Aims: This study sought to investigate the predictors of spontaneous Picture Exchange Communication System (PECS) use in a naturalistic school setting. Method: The study recruited 44 students (36 boys and eight girls), aged between 6 to 18 years and their teachers (26 teachers and two teaching assistants). Teaching staff completed measures of student's communicative ability, autism symptomology and PECS abilities. Teachers also provided information of their PECS training history and PECS teaching experience. Findings: Stepwise Multiple Regression Analysis revealed that: (1) teacher's intentional pre-planning of PECS; (2) context in which PECS is used; (3) PECS phase level; and (4) the number of months of PECS teaching experience teachers had significantly predicted spontaneous PECS use. Child-dependent variables such as the severity of student's autism symptomology and level of student's mastery and age did not significantly predict spontaneous PECS use. Limitations: The limitations of this study are the small sample size, teachers' self-reported bias, and the lack of exploring other potential factors. Conclusions: The findings of the study highlight the importance for professionals, such as Educational Psychologists (EPs), to consider

implementation factors that will impact the efficacy of intervention. In this study, it was the orchestration of how PECS is taught that had significantly predicted better PECS spontaneous use, rather than within-child factors. This suggests that PECS is suitable for a wide range of ASD learners. Additionally, it provides new insights for EPs to emphasise certain components over others during PECS teachers' trainings.

Conklin, C. & Mayer, G.R. (2010). Effects of implementing the Picture Exchange Communication System (PECS) with adults with developmental disabilities and severe communication deficits *Remedial and Special Education (Online First) 2011 32 155-166.*
Abstract: The purpose of this study is to evaluate the effects of Picture Exchange Communication System (PECS) training, using a multiple baseline design on the independent initiations of three adults with developmental disabilities and severe communication deficits. All participants increased their independent initiations, although at different levels of quality and quantity throughout PECS training. Results demonstrate a functional relationship between the teaching of PECS and the increase of independent initiations, and these independent initiations continued to improve after initial training. In addition, problem behaviors (off-task and tantrum behaviors) were monitored to assess the collateral effects of PECS training. Results of data collection on untreated problem behaviors showed marked decreases, especially in the last half of PECS training, and remained below baseline levels during follow-up. The results of this study suggest that participants taught via PECS increased their initiation of requests, thereby increasing their independence and choice making, which also appears to have collateral effects on problem behaviors. This study extends the literature on PECS training with adults with developmental disabilities and severe communication deficits by demonstrating that at least one of the participants learned all six phases. This study also demonstrates collateral changes in untreated problem behaviors in this adult population.

Cooper, L. (2017). Using the Picture Exchange Communication System with families of children with autism. *Learning Disability Practice, 20*, 22-25. **http://doi: 10.7748/ldp.2017.e1842**
Abstract: Children with autism experience difficulties with communication and interaction, and these impairments are most problematic for children who are non-verbal. The Picture Exchange Communication System (PECS) is an intervention strategy that aims to improve communication for people with autism. Using PECS in the family environment can be challenging in the initial stages. The specific needs of individual families should be considered and a whole family approach adopted. With appropriate support and a consistent approach, using PECS can help to improve communication and reduce challenging.

Cummings, A., Carr, J. & LeBlanc, L. (2012). Experimental evaluation of the training structure of the Picture Exchange Communication System (PECS). *Research in Autism Spectrum Disorders, 6, 32-45.*
Abstract: The Picture Exchange Communication System (PECS) is a picture-based alternative communication method that is widely accepted and utilized with individuals with disabilities. Although prior studies have examined the clinical efficacy of PECS, none have experimentally

evaluated its manualized training structure. We experimentally evaluated the effects of training during each of the 6 phases of PECS with 7 children with developmental or language disorders. For all 7 participants, PECS responses consistently increased only after training was completed for each of the first 4 phases but increases in PECS responses occurred during tests of Phases 5 and 6 as soon as training was completed in Phase 4. Consistent with prior research, PECS was taught in a short period of time and required few prerequisite skills. However, 3 of the 7 participants had difficulty with some aspects of training and were able to acquire the targeted skills only after procedural modifications were made.

Danov, S., Hartman, E., McComas, J., & Symons, F. (2010). Evaluation of two communicative response modalities for a child with autism and self-injury. *The Journal of Speech-Language Pathology and Applied Behavior Analysis, 5, 70-79.*
Abstract: There is little empirically replicated guidance from the research literature on selecting a communication response modality when implementing functional communication training (FCT). In this study, two forms of communicative responding (verbal speech and picture cards) were evaluated during FCT treatment of self-injury for a three-year-old boy with autism. The functional analysis indicated the self-injury was maintained by positive reinforcement in the form of access to preferred items. Findings indicated (1) SIB was eliminated during FCT sessions, and (b) independent picture cared (but not verbal speech) were used in all evaluation sessions. Results are discussed in relation to the clinical issue of choosing among different possible communication response modalities to effectively compete with severe problem behavior.

Dionesius, A. R., Esti, W. & Wahidyanti, R. (2017) Effect of PECS (Picture Exchange Communication System) on social interaction development in autistic children. *Nursing News, 2*, 801-810. (Indonesian)
Abstract: Picture Exchange Communication System (PECS) is an approach to train social interaction by using symbols such as pictures. PECS is not limiting Children to interact with anyone. Everyone can easily understand symbols PECS so that children with autism can interact with others not only by his own family. Research Objective is to know the Influence of Application of PECS Method (Picture Exchange Communication System) on Social Interaction Development of Autistic Children in Bahakti Luhur Foundation Malang. This research method is Pre experimental design using the form one group pretest/posttest. The population study is autistic children in Yayasan Bhakti Luhur Malang, amounting to 22 people, The sample study consists of respondents who met the inclusion criteria as many as 14 people, Sampling technique used is Purposive sampling. Data collection techniques used were observation sheet. Data analysis method used is Wilcoxon matched pairs. The results showed that of the 14 respondents' children with autism it can be seen that all of the respondents (100%) to able interact socially well after 8 treatments using PECS method. Obtained results of calculations P-value= 0.000 < α (0.05). So it can be concluded there is influence application of Pecs Method (Picture Exchange Communication System) Against Development Social Interaction In Autism Children In Bakti Luhur Foundation Malang. Is expected that teachers and caregivers can

provide a method of Pecs in a little longer with the media varies so that children with autism can interact very well.

Dogoe, M., Banda, D & Lock, R. (2010). Acquisition and Generalization of the Picture Exchange Communication System Behaviors across Settings, Persons, and Stimulus Classes with Three Students with Autism. *Education and Training in Autism and Developmental Disabilities, 45, 216-229.*
Abstract: A brief narrative description of the journal article, document, or resource. This study examined the acquisition and generalization of requesting behaviors learned through PECS with three children with autism. A single-subject multiple baseline across participants design was used to determine the effects of PECS. Results indicated that all three participants acquired PECS skills for requesting and generalized the skills across settings and persons. However, only two of the three participants met criterion on the generalization across stimulus class probes. Implications and suggestions for future research are discussed. This study provides preliminary data on generalization of PECS across stimulus classes by persons with autism.

Doherty, A., Bracken, M. & Gormley, L. (2018). Teaching children with autism to initiate and respond to peer mands using Picture Exchange Communication System (PECS). *Behavior Analysis in Practice, 11*, 279-288. **https://doi: 10.1007/s40617-018-00311-8**
Abstract: We evaluated the effects of systematic prompting plus reinforcement on listeners' independent responses to peer mands and on speakers' peer-directed mands using the picture exchange communication system (PECS) in two studies. In Study 1, three PECS users with a diagnosis of autism were trained to direct PECS exchanges toward peers, whereas in Study 2, three peers with autism were taught to accept a PECS card, select the requested item from an array of three items, and place it in front of their peer. Study 1 showed an increase in peer PECS mands that generalized to novel trained peers for all participants. Results of Study 2 demonstrated an increase in correct independent responses to PECS exchange for all participants, a response that readily generalized across peers and settings for two out of three participants. These results suggest that this intervention protocol may be an effective way to increase interactions between peers with autism.

Dooley, P., Wilczenski, F. & Torem, C. (2009). Using an activity schedule to smooth school transitions. *Journal of Positive Behavioral Interventions, 3, 57-61.*
Abstract: Functional assessment of a preschool child's aggressive and disruptive behaviors identified antecedent conditions associated with difficulties during transitions from one activity to another at school. Antecedent conditions and functional communication were addressed in the behavior plan using a schedule board based on the Picture Exchange Communication System. A dramatic decrease in aggression and increase in cooperative behavior in the classroom was observed.

Dyer, K., Sulzer-Azaroff, B., & Bondy, A. (May, 2006). Teaching Picture Discrimination to Children with Autism: "Traditional Match-to-Sample" Training vs. "Naturalistic PECS" Training. *Poster presented at the 32nd Annual Association for Behavior Analysis Convention, Atlanta, GA.*
Abstract: Picture discrimination, essential to any picture-based communication program, often is taught through "match-to-sample" (MTS) requests for object-picture pairings. We compared that method to the match-to-sample approach inherent in the Picture Exchange Communication System (PECS). In the traditional MTS condition, we showed the children a picture and asked them to match it to one of a set of objects. Correct matches were rewarded with an item preferred by the child, but unrelated to the sample stimulus; errors were followed with an error correction procedure. In the "naturalistic PECS" condition, a child-preferred and a non-preferred item were displayed. Next, s/he was shown two pictures, each of which corresponded to the items. When s/he handed one of the pictures to the therapist, s/he received the matching item. If the child chose a picture representing an item known to be non-preferred, an error correction procedure followed. Four of 5 children required fewer trials to criterion in the "naturalistic PECS" condition than the "MTS" training condition.

Ferreira, C., Bevilacqua, M., Ishihara, M., Fiori, A., Armonia, A. & Perissinoto, J. (2017). Selection of words for implementation of the Picture Exchange Communication System – PECS in non-verbal autistic children. *Codas. 9;29. (Brazil).*
Abstract: Purpose: It is known that some autistic individuals are considered non-verbal, since they are unable to use verbal language and barely use gestures to compensate for the absence of speech. Therefore, these individuals' ability to communicate may benefit from the use of the Picture Exchange Communication System – PECS. The objective of this study was to verify the most frequently used words in the implementation of PECS in autistic children, and on a complementary basis, to analyze the correlation between the frequency of these words and the rate of maladaptive behaviors. Methods: This is a cross-sectional study. The sample was composed of 31 autistic children, twenty-five boys and six girls, aged between 5 and 10 years old. To identify the most frequently used words in the initial period of implementation of PECS, the Vocabulary Selection Worksheet was used. And to measure the rate of maladaptive behaviors, we applied the Autism Behavior Checklist (ABC). Results: There was a significant prevalence of items in the category "food", followed by "activities" and "beverages". There was no correlation between the total amount of items identified by the families and the rate of maladaptive behaviors. Conclusion: The categories of words most mentioned by the families could be identified, and it was confirmed that the level of maladaptive behaviors did not interfere directly in the preparation of the vocabulary selection worksheet for the children studied.

Fillipin, M., Reszka, S. & Watson, L. (2010). Effectiveness of the Picture Exchange Communication System (PECS) on communication and speech for children with autism spectrum disorders: A Metanalysis. *American Journal of Speech-Language Pathology. (Online version).*
Abstract: Purpose: The Picture Exchange Communication System (PECS) is a popular

communication training program for young children with autism spectrum disorders (ASD). This metanalysis reviews the current empirical evidence for PECS in impacting communication and speech outcomes for children with ASD. Methods: A systematic review of the literature on PECS written between 1994 and June 2009 was conducted. Quality of scientific rigor was assessed and used as an inclusion criterion in computation of effect sizes. Effect sizes were aggregated separately for single subject and group studies for communication and speech outcomes. Results: Eight single-subject experiments (18 participants) and three group studies (95 PECS participants, 65 in other intervention/control) were included. Results indicated PECS is promising, but not as yet established evidenced-based intervention for facilitating communication for children with ASD ages 1–11 years. Small to moderate gains in communication were demonstrated following training. Gains in speech were small to negative. Conclusions: This metanalysis synthesizes gains in communication and relative lack of gains made in speech across the PECS literature for children with ASD. Concerns about maintenance and generalization are identified. Emerging evidence of potential pre-intervention child characteristics are discussed. Phase IV was identified as a possibly influential program characteristic for speech outcomes.

Finkel, A., Weber, K., & Derby, K. (2005). Use of a Braille Exchange Communication System to improve articulation and acquire mands with a legally blind and developmentally disabled female. *Journal of Developmental and Physical Disabilities, 16, 321-336.*
Abstract: This research examined the effectiveness of a Braille Exchange Communication System (BECS) on a legally blind adult with developmental disabilities to determine the effects on word articulation and acquisition of mands. The procedures used a multiple baseline design across four sets of words in a three-phase experiment. Phase one measured word articulation. Phase two measured acquisition of vocal mands. Phase three analyzed the exchange for communication component. Results for phases one and two showed that with verbal prompts and fading procedures, verbal responding increased dramatically. For phase three, using BECS was effective in improving communication exchanges through the use of physical prompting with fading procedures. An additional unique feature of having a third person score IOA data was included to ensure vocal response integrity.

Fleury, V., Trevors, G. & Kendeou, P. (2019). Public perception of Autism treatments: The role of credibility and evidence *Journal of Autism and Developmental Disorders, 49*(5), 1876-1886.
Abstract: We explored the influence of credibility and evidence on public perceptions of ASD treatments using survey methodology. Participants (N = 379) read texts about different ASD treatments. The text presentation was based on a 2 × 2 within-subjects factorial design with treatment status [evidence based practices (EBP) vs. non-EBP] and source credibility in the text (credible vs. non-credible) as the independent variables. An instructional manipulation condition served as a between subjects factor. Respondents were more familiar with non-EBPs than EBPs, but viewed EBPs as being more credible and were more likely to endorse them compared to pseudoscientific practices. Interactions between source credibility and instructional manipulation were found on ratings of credibility and recommendation of both

EBP and non-EBP texts. Implications of these findings are discussed. [Included PECS as an example of EBP.]

Frea, W., Arnold, C. & Vittimberga, G. (2001). A demonstration of the effects of augmentative communication on the extreme aggressive behavior of a child with autism within an integrated preschool setting *Journal of Positive Behavior Intervention, 3, 194-198.*
Abstract: Research in the area of behavior support has repeatedly demonstrated the positive effects of learning more effective and efficient communication on the challenging behaviors of individuals with developmental disabilities. More recently, augmentative and alternative communication strategies have been receiving increased attention as primary teaching goals for young children with autism. Use of picture exchange and choice-making opportunities has been reported to facilitate speech acquisition and/or result in increased communicative attempts across daily routines. The case study discussed in this article examines the effects of picture exchange on the severe aggressive behavior of a preschooler with autism who was at risk of losing his integrated school placement. Picture exchange was introduced within two play routines in the classroom. The effects of picture exchange on the student's aggression were evaluated within a multiple baseline design. Results indicated that the student's aggressive behavior was eliminated in a brief amount of time when picture exchanges were in place. These findings are discussed in terms of integrating augmentative communication into behavioral support planning and future research in this area. (http://www.proedinc.com)

Frost, L. & Bondy, A. (2006). A common language: Using B.F. Skinner's Verbal Behavior for assessment and treatment of communication disabilities in SLP-ABA. *The Journal of Speech and Language Pathology - Applied Behavior Analysis, 1, 103-110.*
Abstract: Professionals in the field of speech-language pathology (SLP) and applied behavior analysis (ABA) share a common goal in the treatment of communication disorders. The two fields, however, do not share a common language. Skinner's definition of verbal behavior and his classification of verbal operants provide interventionists with a valuable tool for classifying verbal behavior based on controlling variables. An understanding of the primary verbal operants and operants under multiple control are essential for planning efficient verbal behavior intervention. This paper presents a primer on B.F. Skinner's 1957 publication, Verbal Behavior, a description of the primary verbal operants, verbal operants under multiple control, and a discussion of using this taxonomy for writing precise communication goals for effective intervention.

Frost, L. (2002). The Picture Exchange Communication System. *Perspectives on Language Learning and Education, 9, 13-16.*

Fujimoto, Y. & Isawa, S. (2007). The practical study on approach to secondary disorders in student with autistic disorder at school for children with mental retardation: Effect of individualized schedule and applied PECS. *Hattatsu Shinri Rinsyo Kenkyu, 13, 129-135.*
Abstract: The subjects in this study was a student (CA:17-0, DA:1-11, SA:2-5) with autistic

disorder at school for children with mental retardation. He presented states such as secondary disorders and “Persistence to opening or closing of a door” “sleeplessness” “overeating” from it was thought with an environmental change of department of high school from department of junior high school. The making the environmental that the student is easy to understand that he should perform “when” “what” “how long” and training mand based on applied PECS (The Picture Exchange Communication System) to express his demands were conducted. This study was aimed at examining the process and effect of that support. We discussed reason of the process of and effect and considered ideal method of support in department of school of children for mental retardation.

Ganz, J. & Simpson, R. (2004). Effects on communicative requesting and speech development of the Picture Exchange Communication System in children with characteristics of autism. *Journal of Autism and Developmental Disabilities, 34, 395-409**.***
Abstract: Few studies on augmentative and alternative communication (AAC) systems have addressed the potential for such systems to impact word utterances in children with autism spectrum disorders (ASD). The Picture Exchange Communication System (PECS) is an AAC system designed specifically to minimize difficulties with communication skills experienced by individuals with ASD. The current study examined the role of PECS in improving the number of words spoken, increasing the complexity and length of phrases, and decreasing the non-word vocalizations of three young children with ASD and developmental delays (DD) with related characteristics. Participants were taught Phases 1–4 of PECS (i.e., picture exchange, increased distance, picture discrimination, and sentence construction). The results indicated that PECS was mastered rapidly by the participants and word utterances increased in number of words and complexity of grammar.

Ganz, J., Earles-Vollrath, T., Heath, A., Parker, R., Rispoli, M. & Duran, J. (2012). A Meta-Analysis of Single Case Research Studies on Aided Augmentative and Alternative Communication Systems with Individuals with Autism Spectrum Disorders. *Journal of Autism and Developmental Disorder, 42, 60-74.*
Abstract: Many individuals with autism cannot speak or cannot speak intelligibly. A variety of aided augmentative and alternative communication (AAC) approaches have been investigated. Most of the research on these approaches has been single-case research, with small numbers of participants. The purpose of this investigation was to meta-analyze the single case research on the use of aided AAC with individuals with autism spectrum disorders (ASD). Twenty-four single-case studies were analyzed via an effect size measure, the Improvement Rate Difference (IRD). Three research questions were investigated concerning the overall impact of AAC interventions on targeted behavioral outcomes, effects of AAC interventions on individual targeted behavioral outcomes, and effects of three types of AAC interventions. Results indicated that, overall, aided AAC interventions had large effects on targeted behavioral outcomes in individuals with ASD. AAC interventions had positive effects on all of the targeted behavioral outcome; however, effects were greater for communication skills than other categories of skills. Effects of the Picture Exchange Communication System and speech-

generating devices were larger than those for other picture-based systems, though picture-based systems did have small effects.

Ganz, J., Goodwyn, F., Boles, M., Hong, E., Rispoli, M., Lund, E. & Kite, E. (2013). Impacts of a PECS instructional coaching intervention on practitioners and children with autism. *AAC: Augmentative and Alternative Communication, 29, 210-221.*
Abstract: There is a growing research literature on the potential benefits of augmentative and alternative communication (AAC) for individuals with autism; however few studies have investigated implementation of AAC within real-life contexts. Thus, the purpose of this study was to investigate the impact of training for practitioners in implementation of aided AAC, and to examine implementation of Picture Exchange Communication System (PECS) in real-life contexts. In particular, this study involved the implementation of instructional coaching to increase opportunities offered by behavioral therapists for their preschool-aged clients to use PECS to make requests. Results indicated increases in therapist implementation of AAC and client use of AAC in trained contexts, with limited generalization to untrained contexts.

Ganz, J., Heath, A., Rispoli, M. & Earles-Vollrath, T. (2010)., Impact of AAC versus verbal modeling on verbal imitation, picture discrimination, and related speech: A pilot investigation. *Journal of Developmental and Physical Disability, 22, 179-196.*
Abstract: Delays in or lack of language development are a primary characteristic of autism. Thus, teachers, families and researchers face the challenge of determining which teaching strategies are most effective and efficient in addressing these communication deficits. This study attempts to add to the literature regarding this issue. A multi-treatment/multi-measure single-case design was used to compare the effects of the Picture Exchange Communication System (PECS) with a verbal modeling intervention on four communicative behaviors: (a) picture requests, (b) imitated verbalizations, (c) picture discrimination, and (d) any related speech for a 3 year old child with autism. Results indicated that the PECS training led to increases in picture requests and these results were maintained during the verbal modeling intervention phase. No change in imitated verbalizations was observed following either intervention. With respect to both picture discrimination and related speech, no significant results were achieved following PECS training or verbal modeling. However, during the verbal modeling phase the participant demonstrated a small increase in both picture discrimination and any related speech for both the PECS and verbal modeling item sets.

Ganz, J., Hong, E. & Goodwyn, F. (2013). Effectiveness of the PECS Phase III app and choice between the app and traditional PECS among preschoolers with ASD. *Research in Autism Spectrum Disorders, 7, 973-983.*
Abstract: We investigated the efficacy of a tablet-computer-based Picture Exchange Communication System (PECS) application for use with three preschoolers with ASD and investigated participant preference for the app versus traditional PECS (i.e., with a physical communication book) once the participants demonstrated minimal levels of mastery of both. We implemented a single-case multiple baseline design to determine the efficacy of the app.

Results indicated that participants rapidly demonstrated above-chance level mastery of the app. Following mastery, two participants demonstrated a preference for the app, while the other preferred the traditional PECS communication book.

Ganz, J., Mason, R., Goodwyn, F., Boles, M., Heath, A., & Davis, J. (2014). Interaction of participant characteristics and type of AAC with individuals with ASD: A meta-analysis. *American Journal on Intellectual and Developmental Disabilities, 119, 516-535.*
Abstract: Individuals with autism spectrum disorders (ASD) and complex communication needs often rely on augmentative and alternative communication (AAC) as a means of functional communication. This meta-analysis investigated how individual characteristics moderate effectiveness of three types of aided AAC: the Picture Exchange Communication System (PECS), speech-generating devices (SGDs), and other picture-based AAC. Effectiveness was measured via the Improvement Rate Difference. Results indicated that AAC has small to moderate effects on speech outcomes, and that SGDs appear to be most effective when considering any outcome measure with individuals with ASD without comorbid intellectual/developmental disorders (IDD). PECS appears to be most effective when considering any outcome measure with individuals with ASD and IDD. SGDs and PECS were the most effective type of AAC for preschoolers, when aggregating across outcome measures. No difference was found between systems for elementary-aged and older individuals.

Ganz, J., Parker, R. & Benson, J. (2009). Impact of the picture exchange communication system and collateral effects on maladaptive behavior. *Augmentative and Alternative Communication, 25, 250-261.*
Abstract: Many children with autism require intensive instruction in the use of augmentative or alternative communication systems, such as the Picture Exchange Communication System (PECS). This study investigated the use of PECS with three young boys with autism to determine the impact of PECS training on use of pictures for requesting, use of intelligible words, and maladaptive behaviors. A multiple baseline-probe design with a staggered start was implemented. Results indicated that all of the participants quickly learned to make requests using pictures and that two used intelligible speech following PECS instruction; maladaptive behaviors were variable throughout baseline and intervention phases. Although all of the participants improved in at least one dependent variable, there remain questions regarding who is best suited for PECS and similar interventions.

Ganz, J., Rea Hong, E., Goodwyn, F., Kite, E. & Gilliland, W. (2015). Impact of PECS tablet computer app on receptive identification of pictures given a verbal stimulus. *Developmental Neurorehabilitation, 18, 82-87.*
Abstract: Objective: The purpose of this brief report was to determine the effect on receptive identification of photos of a tablet computer-based augmentative and alternative communication (AAC) system with voice output. Methods: A multiple baseline single-case experimental design across vocabulary words was implemented. One participant, a preschool-aged boy with autism and little intelligible verbal language, was included in the study. Results:

Although a functional relation between the intervention and the dependent variable was not established, the intervention did appear to result in mild improvement for two of the three vocabulary words selected. Conclusion: The authors recommend further investigations of the collateral impacts of AAC on skills other than expressive language.

Ganz, J., Sigafoos, J., Simpson, R., & Cook, K. (2008). Generalization of a picture alternative communication system across instructors and distance. *Augmentative and Alternative Communication, 24, 89-99.*
Abstract: Nonverbal individuals with autism spectrum disorders (ASD) often require the use of picture based, aided augmentative and alternative communication (AAC) systems. Such systems are used widely, but little research has investigated the generalization of these devices to a variety of communicative partners and under a variety of conditions. We investigated use of a modified Picture Exchange Communication System (PECS) protocol to teach AAC supported functional communication skills to a 12-year-old boy with autism. Results indicate that the participant was able to generalize his communication skills across a variety of instructors and to use functional non-verbal strategies to respond to communication obstacles.

Ganz, J., Simpson, R. & Corbin-Newsome, J. (2008). The impact of the Picture Exchange Communication System on requesting and speech development in preschoolers with autism spectrum disorders and similar characteristics. *Research in Autism Spectrum Disorders, 2, 157–169.*
Abstract: By definition children with autism spectrum disorders (ASD) experience difficulty understanding and using language. Accordingly, visual and picture-based strategies such as the Picture Exchange Communication System (PECS) show promise in ameliorating speech and language deficits. This study reports the results of a multiple baseline across participants investigating the implementation of the PECS with three preschool children with characteristics of ASD. The first four phases of PECS were taught to the participants: basic picture exchange, increasing distance use of PECS, discriminating among a variety of pictures, and communicating in sentences composed of pictures. Relative to the impact of PECS's implementation in providing the participants with a functional communication system, word approximations, and intelligible word and phrase use, results indicated that two of the three participants mastered PECS. However, participants did not significantly increase in use of word approximations and intelligible words.

Ganz, J., Simpson, R. & Lund, E. (2012). The Picture Exchange Communication System (PECS): A Promising Method for Improving Communication Skills of Learners with Autism Spectrum Disorders. *Education and Training in Autism and Developmental Disabilities, 47, 176–186.*
Abstract: Children and youth with autism spectrum disorders (ASD) and other developmental delays frequently experience deficits in functional communication. Identifying and using suitable communication enhancement and augmentative and alternative communication supports is essential to achievement of positive outcomes for these learners. This article discusses the use of the Picture Exchange Communication System (PECS), a commonly used and

utilitarian AAC system for children and youth who lack sufficient functional communication skills. Particular attention is given to practitioners' use of this promising tool.

Ganz, J.B., Cook, K.E., Corbin-Newsome, J., Bourgeois, B., & Flores, M. (2005). Variations on the Use of a Pictorial Alternative Communication System with a Child with Autism and Developmental Delays. *TEACHING Exceptional Children Plus, 1(6) Article 3.*
Abstract: As aberrant behavior is often recognized as the number one form of communication, it becomes imperative that as parents, teachers, and educators we must address and systematically teach or provide all children with an effective means of communication. While many augmentative and alternative communication systems such as manual sign language and the Picture Exchange Communication System (Frost & Bondy, 1994) have shown tremendous success, some students with developmental disabilities students unique needs require more individually tailored communication training that necessitates empirical inquiry and use of collective expertise. Doing so may facilitate the acquisition of skills and behaviors that improve communication skills through independent appropriate means for meeting students' personal needs and desires. This article systematically provides a variation of the Picture Exchange Communication System (PECS) including materials, resources, and methodology necessary. (http://escholarship.bc.edu/education)

Gilroy, S., Leader, G. & McCleery, J. (2018). A pilot community-based randomized comparison of speech generating devices and the picture exchange communication system for children diagnosed with autism spectrum disorder *Autism Research, 11* ***https://doi: 10.1992/aur.2025***
Abstract: A pilot community-based randomized controlled trial was conducted to compare the effects of the Picture Exchange Communication System (PECS) to a teaching sequence using a high-tech Speech Generating Device (SGD) to teach social communication behaviors. The two approaches were compared to evaluate the effectiveness of the newer, more high-tech intervention using technology to improve social and communicative behavior of children diagnosed with Autism Spectrum Disorder. A total of 35 school-age children were randomized to either a high-tech (SGD device) or low-tech (PECS cards) form of Augmentative and Alternative Communication (AAC). Study participants received 4 months of communication training delivered in their classrooms, and the primary outcome measures of the trial were several functional communication skills emphasized in the PECS teaching sequence. Results indicated that both high-tech and low-tech AAC approaches resulted in significant improvements in communication, and that these improvements did not differ significantly between the two approaches. These findings support the use of high-tech AAC and highlight the need for evidence-based guidelines for its use as well as evaluation with individuals with a range impairments and disabilities. Autism Res 2018. © 2018 International Society for Autism Research, Wiley Periodicals, Inc. Lay Summary This study compared the effectiveness of a free and open-source app for teaching social and communicative behavior to children with autism spectrum disorder (ASD) to traditional picture card approaches. Thirty-five children with ASD were randomized to a picture card or app-based intervention and both treatment approaches resulted in significant improvements in social and communicative behavior. These data

indicated that both “high-tech” and “low-tech” interventions were effective for improving behavior and that there was not a significant difference between the two approaches.

Gilroy, S., McCleery, J. & Leader, G. (2017). Systematic Review of Methods for Teaching Social and Communicative Behavior with High-Tech Augmentative and Alternative Communication Modalities *Review Journal of Autism and Developmental Disorders, 4, 307-320.*
Abstract: A systematic review was conducted to analyze the scope and breadth of the existing training protocols for establishing social and communicative behavior using high-tech, touchscreen devices. This review aimed to determine the degree to which studies evaluating high-tech communication aides have established procedures to extend, or completely replace, traditional low-tech communication training methods (e.g., Picture Exchange Communication System). Individual studies were evaluated based on the range of social and communicative skills targeted. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology was utilized (Prospero: No. CRD42017055541) and systematic searches included the Scopus, PsycINFO, ScienceDirect, and SpringerLink databases. Studies were included in the review if their methods utilized high-tech devices as a vehicle for establishing social and/or communicative behavior. Single-case and group-design studies including children and adults were included in the review if participants were diagnosed with either autism spectrum disorder and/or other developmental disabilities. Fifty-six studies were included and the results of this review indicated that the existing support for high-tech communication aides has focused predominantly on a narrow band of social and communicative behavior (e.g., requesting) and that substantial research is warranted for establishing more advanced forms of social behavior, beyond requesting alone, using these new high-tech methods.

Gopalan, RT & Piking, ET. (2016). The Effectiveness of the Picture Exchange Communication System (PECS) in autism. *Imperial Journal of Interdisciplinary Research, 2, 455-461. (Malaysia).*
Abstract: The purpose of this study was to determine the effectiveness of the use of the Picture Exchange Communication System (PECS) on the improvement of functional communication skills among children with autism. Method: Case study design with pre and post assessment was used. A four year old child diagnosed to have autism was participated in the study. In the study only two of the six PECS phases (the Physical Exchange and Distance and Persistence) were selected to teach the child because of lack of language ability. Result: The data from this study indicates that in terms of the PECS acquisition data in phase 1 and 2, and the PECS did improve the participant’s functional communication skills, especially the ability to request edibles, toys or activities, given choice and greeting. Conclusion: A visual inspection of the data collected revealed that overall the participant in the study had improved some functional communication skills that would allow him to appropriately communicate his basic wants and needs which indicate that PECS is effective.

Gordon, K., Pasco, G., McElduff, F., Wade, A., Howlin, P. & Charman, T. (2011). A communication-based intervention for nonverbal children with autism: What changes? Who benefits? *Journal of Consulting and Clinical Psychology, 79, 447-457.*
Abstract: Objective: This article examines the form and function of spontaneous communication and outcome predictors in nonverbal children with autism following classroom-based intervention (Picture Exchange Communication System [PECS] training). Method: 84 children from 15 schools participated in a randomized controlled trial (RCT) of PECS (P. Howlin, R. K. Gordon, G. Pasco, A. Wade, & T. Charman, 2007). They were aged 4–10 years (73 boys). Primary outcome measure was naturalistic observation of communication in the classroom. Multilevel Poisson regression was used to test for intervention effects and outcome predictors. Results: Spontaneous communication using picture cards, speech, or both increased significantly following training. Spontaneous communication to request objects significantly increased. Only the effect on spontaneous speech persisted by follow-up (9 months later). Less severe baseline autism symptomatology was associated with greater increase in spontaneous speech and less severe baseline expressive language impairment, with larger increases in spontaneous use of speech and pictures together. Conclusion: Overall, PECS appeared to enhance children's spontaneous communication for instrumental requesting using pictures, speech, or a combination of both. Some effects of training were moderated by baseline factors. For example, PECS appears to have increased spontaneous speech in children who could talk a little at baseline.

Greenberg, A., Tomaino, M. & Charlop, M. (2013). Adapting the Picture Exchange Communication System to Elicit Vocalizations in Children with Autism *Journal of Developmental and Physical Disabilities, DOI 10.1007/s10882-013-9344-2.*
Abstract: Little is known about the relationship between PECS training and vocalizations in children with limited verbal abilities (e.g., children who are unable to verbally imitate simple phrases). Study 1 used a multiple baseline design across children to examine the vocalizations of four children with autism during and after PECS training. At follow-up, three of the participants demonstrated higher frequencies of vocalizations than at baseline. Further, two of these participants used both PECS and vocalizations to mand at different times but did not pair the two modalities. Study 2 was then conducted to determine if children with limited verbal abilities could be taught to pair PECS with spontaneous vocalizations using time-delay and verbal prompting procedures. By the end of Study 2, both participants made a spontaneous vocalization every time that they used PECS. Findings support the potential use of PECS as a component of a treatment package leading to verbal speech. 13.5

Greenberg, A., Tomaino, M.A.E. & Charlop, M. (2012). Assessing Generalization of the Picture Exchange Communication System in Children with Autism. *Journal of Developmental and Physical Disabilities, 24, 539-558.*
Abstract: Since its introduction to the field, a growing body of research on the Picture Exchange Communication System (PECS) has demonstrated its efficacy for children with autism in research settings. However, knowledge of PECS generalization remains limited and mixed. The

present study explored a train and probe technique of assessing generalization after each phase of PECS training. Four children with autism were taught PECS in treatment rooms with a therapist at their behavioral treatment program. Generalization was assessed in a playroom with a therapist, at home with a therapist and parent, and in the community with a stranger. Results indicated that all four participants generalized PECS use across settings and people and maintained PECS use at follow-up. Findings provide support for the utility of a train and probe technique to assess generalization when using PECS with children with autism.

Greenburg, A., Tomaino, M., & Charlop, M. (2014). Adapting the Picture Exchange Communication System to elicit vocalizations in children with autism. *Journal of Developmental and Physical Disabilities, 26, 35-51.*
Abstract: Little is known about the relationship between PECS training and vocalizations in children with limited verbal abilities (e.g., children who are unable to verbally imitate simple phrases). Study 1 used a multiple baseline design across children to examine the vocalizations of four children with autism during and after PECS training. At follow-up, three of the participants demonstrated higher frequencies of vocalizations than at baseline. Further, two of these participants used both PECS and vocalizations to mand at different times, but did not pair the two modalities. Study 2 was then conducted to determine if children with limited verbal abilities could be taught to pair PECS with spontaneous vocalizations using time-delay and verbal prompting procedures. By the end of Study 2, both participants made a spontaneous vocalization every time that they used PECS. Findings support the potential use of PECS as a component of a treatment package leading to verbal speech.

Haramaki, S. & Bondy, A. (2007). Behavior analytic approach to Asperger Syndrome. *Nippon Rinsho, 65, 516-21.*
Abstract: We describe the behavior analytic approach to helping people with Asperger syndrome regarding social interaction and communication issues. In the behavior analytic approach, the cause of maladaptive behavior is not attributed to the disability itself. Maladaptive behaviors are viewed as a function of the interaction between an individual and the environment. Therefore, we assess these functional relationships and intervene by modifying aspects of the environment. Functional assessment is one of the most effective methods to evaluate the cause of problem behaviors and helps in the selection of an intervention strategy. We teach students functionally equivalent alternative behaviors that are socially appropriate and yet met the needs of the individual. Furthermore, we discuss the importance of teaching individuals with Asperger syndrome critical skills, including communication skills, self-management skills, and how to deal with anxiety.

Hart, S. & Banda, D. (2009). Picture Exchange Communication System with individuals with developmental disabilities: A meta-analysis of single subject studies. *Remedial and Special Education (Online First), XX, 1-13.*
Abstract: Picture Exchange Communication System (PECS) is a picture-based communication strategy used to teach communication skills to persons with developmental disabilities

including autism. This article systematically reviews 13 published single subject studies to examine the effectiveness of PECS, the effects of PECS on speech and problem behaviors, generalization beyond training conditions, and social validity of the intervention. The authors also calculated percentage of non-overlapping data points for all participants to quantify, compare, and analyze results. Results indicate that PECS yielded increases in functional communication in all but 1 participant. Additionally, PECS decreased problem behaviors and increased speech in some individuals. A theoretical framework, analyses of methodologies, and implications for researchers and practitioners are discussed.

Heneker, S. & Page, L.M. (2003). Functional Communication: the impact of PECS. *Speech & Language Therapy in Practice, 12-14.*
Abstract: The Picture Exchange Communication System (PECS™) aims to teach individual users to initiate communication. The effectiveness of introducing this approach to whole classes within a school for autistic spectrum disordered children was investigated in two groups. Class staff and parents attended a formal PECS training course and the impact on the amount, functions and method of communication and the level of adult support required were recorded. Observations were carried out in four different contexts: free play, snack, swimming and structured teaching. For group 1 children, aged 6 to 8, the amount of communication increased in all activities apart from swimming. Requesting was the most frequent function at both base-line and follow-up. The most frequently used method of communication at base-line was by symbols. At follow-up symbols was the main method for snack and structured teaching and physical communication was predominant for free-play and swimming. The presence of an object/event was the main level of stimulus to which children responded for all activities. For Group 2 children, aged 9-10 years, total communicative acts increased for all activities apart from structured teaching, where the decrease may have been due to their being taught more independent skills of commenting for the first time. Requesting remained the most frequent function of communication, and more formal means of communication were observed. The presence of an object/event remained the main stimulus for snack and swimming, but more independent responses were seen in free-play, with the presence of a listener becoming the level of cue required to initiate communication. At follow-up, children involved in the study appeared to show less frustration, were able to accept that their requests might not always be met, and could wait patiently for adult attention.

Hill, D. & Flores, M. (2014). Comparing the Picture Exchange Communication System and the iPad™ for communication of students with autism spectrum disorder and developmental delay *TechTrends, 58, 45-53.*
Abstract: Both picture exchange, a low-tech picture based communication system, and technology based interventions, such as the iPad™ with communication application, are emerging treatments for students with autism spectrum disorder (ASD), according to the National Autism Center (2009). Recently, investigations regarding the use of the Apple iPad™ to communicate have been conducted with mixed results. The authors used a single-subject alternating treatment design during an extended school year (ESY) program for students with

disabilities to compare the independent use and effectiveness of the two approaches (low-tech picture-based versus iPad™ equivalent) for three pre-school and two elementary students with ASD and developmental delay (DD). The authors concluded that teaching low-tech picture exchange prior to introducing the iPad™ may be effective progression in teaching communication reciprocity skills for some students with ASD/DD. Limitations and strengths of both technologies are discussed. NOTED: "The authors recommend that PECS™ phases I-III be mastered before the iPad™ is introduced, to ensure the students master these prerequisite skills since they are more difficult to scaffold (break into smaller units for teaching and then build additional skills) using the iPad™.

Hill, D., Flores, M., & Kearley, R. (2014). Maximizing ESY services: Teaching pre-service teachers to assess communication skills and implement picture exchange with students with autism spectrum disorder and developmental disabilities. *Teacher Education and Special Education: The Journal of the Teacher Education Division of the Council for Exceptional Children, 37, 241-254.*
Abstract: The authors supervised and trained pre-service teachers while conducting extended school year (ESY) services for pre-kindergarten and elementary students with autism spectrum disorder (ASD) and other developmental disabilities (DD). Each classroom was responsible for conducting communication assessments and developing interventions focused on increasing functional communication. One intervention, the Picture Exchange Communication System (PECS™), was taught to three pre-service teachers and staff who implemented PECS™ with four students who lacked functional communication skills. The teachers were mentored as they implemented the appropriate level of PECS™ and developed communication books for the students to use in school, home, and other settings.

Homlitas, C., Rosales, R. & Candel, L. (2014). A further evaluation of behavioral skills training for implementation of the Picture Exchange Communication System. *Journal of Applied Behavior Analysis, 47, 198-203.*
Abstract: We evaluated the effectiveness of a behavioral skills training package to teach implementation of Phases 1, 2, and 3A of the picture exchange communication system (PECS) to teachers employed at a therapeutic center for children with autism. Probes in the natural environment and follow-up were conducted with children who were assigned to work with the teachers in their own classrooms. Results provide additional support for the efficacy of behavioral skills training to each implementation of PECS.

Howlin, P., Gordon, R.K., Pasco, G., Wade, A. & Charman, T. (2007). The effectiveness of Picture Exchange Communication System (PECS) training for teachers of children with autism: a pragmatic, group randomised controlled trial. *Journal of Child Psychology and Psychiatry, 48, 473-481.*
Abstract: Objective: To assess the effectiveness of expert training and consultancy for teachers of children with autism spectrum disorder in the use of the Picture Exchange Communication System (PECS). Method: Design: Group randomised, controlled trial (3 groups: immediate

treatment, delayed treatment, no treatment). Participants: 84 elementary school children, mean age 6.8 years. Treatment: A 2-day PECS workshop for teachers plus 6 half-day, school-based training sessions with expert consultants over 5 months. Outcome measures: Rates of: communicative initiations, use of PECS, and speech in the classroom; Autism Diagnostic Observation Schedule-Generic (ADOS-G) domain scores for Communication and Reciprocal Social Interaction; scores on formal language tests. Results: Controlling for baseline age, developmental quotient (DQ) and language; rates of initiations and PECS usage increased significantly immediately post-treatment (Odds Ratio (OR) of being in a higher ordinal rate category 2.72, 95% confidence interval 1.22–6.09, $p < .05$ and OR 3.90 (95%CI 1.75–8.68), $p < .001$, respectively). There were no increases in frequency of speech, or improvements in ADOSG ratings or language test scores. Conclusions: The results indicate modest effectiveness of PECS teacher training/consultancy. Rates of pupils' initiations and use of symbols in the classroom increased, although there was no evidence of improvement in other areas of communication.

Hu, X. & Lee, G. (2018). Effects of PECS on the emergence of vocal mands and the reduction of aggressive behavior across settings for a child with Autism, *Behavioral Disorders*, *44*, 1-12. **https://doi.org/10.1177/0198742918806925**
Abstract: Effective strategies to address communication and behavior challenges are critical in early intervention programs. The purpose of this study was to investigate the effects of the Picture Exchange Communication System (PECS) on vocal mands and aggressive behavior displayed by a child with autism in China. One 4-year-old boy with autism participated in this study. The experimental design was a multiple baseline across three settings. The PECS intervention involved the first three phases described in the PECS manual. The results indicated that PECS effectively increased vocal mands and decreased aggressive behavior maintained by access to preferred items in all three settings. The results also suggested that vocal mands were potentially controlled by pictures in the PECS book. One week following the completion of the intervention, the child maintained the PECS exchanges at a high level with increased vocal mands. His aggressive behavior remained at almost zero occurrences. Results of this study have important implications to early intervention educators working with children with autism.

Hughes-Lika, J. & Chiesa, M. (2020). The picture exchange communication system and adults lacking functional communication: A research review. *European Journal of Behavior Analysis*, https://doi.org/10.1080/15021149.2020.1815507.
ABSTRACT: PECS training for children with Autism Spectrum Disorder and Intellectual Disabilities has been extensively evaluated. In contrast, there is a dearth of literature on outcomes of PECS training for adults lacking functional communication skills. A literature search produced five empirical studies involving PECS training with 18 adults. The participants involved presented with a wider range of intellectual and physical challenges than those typically found in child-related research. Where noted, severity of diagnoses ranged from mild to profound and included participants with single, dual and triple diagnoses, the majority with dual diagnoses. Each of the studies shows results in line with child-related research. While the amount of research is limited, the outcomes of these few studies are profound in their implications for

adults with a variety of intellectual disabilities and physical challenges. Implications for both children and adults are considered.

Ivy, S., Hatton, D. & Hooper, J. (2014). Using the Picture Exchange Communication System with students with visual Impairment. *Exceptional Children, 80, 474-488.*
Abstract: Students with visual impairment (VI) were taught to request using the Picture Exchange Communication System (PECS) and tangible symbols. Participants were four males with additional disabilities, 5 to 11 years old, who had little to no functional vision. A functional relation between PECS Phase 1 and requesting was established using a multiple baseline single subject design. All students learned to request independently within 7 to 14 sessions in Phase 1. Students maintained requesting above criterion for 1 to 5 months. All students generalized requesting to a new communication partner (CP); however, only two students reached criterion during generalization sessions. Two students learned to seek out a CP 5 feet away to request; however, no functional relation was established for Phase 2. More research is needed to establish PECS as an evidence-based practice for children with VI.

Isshiki, M., Ishiyama, A., Yoshida, S., Hisatake, Y., & Terada, S. (2008). A complex effect of PECS and cognition intervention for autism spectrum disorder *Bulletin of the Faculty of Education, Kochi University, 68, 73-82.*
Abstract: We introduced interventions of both the Picture Exchange Communication System (PECS) and the cognition to four participants with autism Spectrum disorder who use few words and have poor communication skills. As a result, the participants improved in each phases of the PECS, and acquired a spontaneous demand skill to use the PECS in the intervention setting. We also improved the PECS intervention to their daily lives, therefore they showed a spontaneous demand skill in a non-structured setting in the daily living. Simultaneously, we taught cognitive tasks to the participants. We found that the levels of cognitive tasks correspond to the PECS phases. Accordingly, it was suggested that the psychological operation acquired by the cognitive intervention, work as the base for the necessary operation in the PECS intervention.

Jurgens, A., Anderson, A. & Moore, D. (2009). The effect of teaching PECS to a child with autism verbal behaviour, play, and social functioning. *Behaviour Change, 26, 66-81.*
Abstract: The Picture Exchange Communication System (PECS) is a widely used intervention strategy designed to teach communication skills to children with developmental delays, including autism. The Picture Exchange Communication System incorporates the teaching of mand initiations that are thought to be pivotal response behaviours, and have been demonstrated to lead to generalised improvements in other nontargeted behaviours. The aim of the present study was to assess the acquisition of PECS with a 3-year-old boy with autism using the established PECS training program, and to evaluate concomitant changes in spoken language, social–communicative behaviours, and functional play. Results indicated that the participant rapidly acquired the criterion behaviours for Phases 1 to 3 of the PECS program. Although PECS exchanges were rarely observed in the generalization settings, clear increases

were evident in verbal mands and other initiations in both home and kindergarten generalisation settings. Increases in spoken vocabulary and in the length of comprehensible spoken utterances in free-play were observed, as were gains in time spent in developmentally appropriate play. Implications of these results and directions for future research are discussed.

Jurgens, A., Anderson, A. & Moore, D. (2012). Parent-implemented Picture Exchange Communication System (PECS) training: An analysis of YouTube videos. *Developmental Neurorehabilitation, 15, 351-360.*
Abstract: Purpose: To investigate the integrity with which parents and carers implement PECS in naturalistic settings, utilizing a sample of videos obtained from YouTube. Methods: Twenty-one YouTube videos meeting selection criteria were identified. The videos were reviewed for instances of seven implementer errors and, where appropriate, presence of a physical prompter. Results: Forty-three per cent of videos and 61% of PECS exchanges contained errors in parent implementation of specific teaching strategies of the PECS training protocol. Vocal prompts, incorrect error correction and the absence of timely reinforcement occurred most frequently, while gestural prompts, insistence on speech, incorrect use of the open hand prompt and not waiting for the learner to initiate occurred less frequently. Conclusions: Results suggest that parents engage in vocal prompting and incorrect use of the 4-step error correction strategy when using PECS with their children, errors likely to result in prompt dependence.

Jurgens, A., Anderson, A. & Moore, D. (2018). Maintenance and generalization of skills acquired through picture exchange communication system (PECS) training: a long-term follow-up. Journal of *Developmental Neurorehabilitation, 22*, 338-347. **https://doi.org/10.1080/17518423.2018.1503619**
Abstract: Purpose: To conduct a follow-up assessment of the maintenance of communication skills of a 7-year-old child with autism spectrum disorder, 3 years 7 months post PECS training; and investigate the effects of environmental adaptations on the child's PECS and vocal communications. Methods: An alternating-treatments design enabled comparison of the effects of two treatment conditions (an environmental adaptation to increase need and opportunities for communication, versus a continuation of baseline procedures) on the child's PECS and vocal communications in the child's home. Results: Baseline data demonstrated decreased levels of PECS and vocal communication at follow-up, compared to post PECS training 3 years 7 months prior. The environmental adaptation had no observable effect on the participant's use of PECS, but vocal manding increased in this condition. Conclusion: These results suggest ongoing need for motivating environments with ample opportunities to practice post PECS training. Implications and directions for future research are discussed.

Jusob, W. & Majid, R. A. (2017). Using the Picture Exchange Communication System to improve speech utterance among children with Autism. *Journal of ICSAR, 1, 1-4. [Malaysia]*
Abstract: Picture Exchange Communication System is a common augmentative communication system used on children with Autism Spectrum Disorder (ASD), which is one of the categories of developmental problems in social interaction, communication and behavior patterns. The aim

of this study is to see an increase in the utterance of the word by students with autism using PECS. This study is an action research using quantitative descriptive on data collection. Observations were implemented over a period of four weeks to see the effectiveness of PECS using cartoon picture cards and cards real pictures to enhance the utterance of two primary school autism students. From the result shown, the application of PECS successfully stimulates utterance among the students. This study is expected to enhance the communication and social interaction development of children with autism and other children who have difficulty mastering the language.

Jusob, W. & Majid, R. A. (2017). Using the Picture Exchange Communication System to improve speech utterance among children with Autism. *Journal of ICSAR, 1*, 1-4. [Malaysia]
Abstract: Picture Exchange Communication System is a common augmentative communication system used on children with Autism Spectrum Disorder (ASD), which is one of the categories of developmental problems in social interaction, communication and behavior patterns. The aim of this study is to see an increase in the utterance of the word by students with autism using PECS. This study is an action research using quantitative descriptive on data collection. Observations were implemented over a period of four weeks to see the effectiveness of PECS using cartoon picture cards and cards real pictures to enhance the utterance of two primary school autism students. From the result shown, the application of PECS successfully stimulates utterance among the students. This study is expected to enhance the communication and social interaction development of children with autism and other children who have difficulty mastering the language.

Kern, L., Gallagher, P., Starosta, K., Hickman, W. & George, M. (2006). Longitudinal outcomes of functional behavioral assessment–based intervention. *Journal of Positive Behavior Interventions, 8, 67–78.*
Abstract: A critical measure of intervention effectiveness is durability over time. Still, few studies have examined the long-term outcomes of support derived from a functional behavioral assessment as well as enablers and barriers that contribute to or impede successful outcomes. In the current study, a functional behavioral assessment was conducted with a 10-year-old boy with developmental disabilities who engaged in high-rate aggression. Based on the assessment results, a comprehensive support plan was developed and implemented, which resulted in a decrease in aggression and increase in activity engagement. His subsequent progress was followed for 3 consecutive school years. This longitudinal follow-up indicated that components of the plan remained effective; however, illness and implementation lapses resulted in decrements in progress.

Khoiriyah, K. (2016). The Picture Exchange Communication System: An approach to optimize communication ability of autistic children. *International Conference on Education, 1, 237-247. (Indonesia.)*
Abstract: The communication barrier is a disorder condition that is often found among the autistic children. Therefore, we need an approach to optimize the communication ability of the

autistic children. PECS is very effective to help the autistic children to communicate and to control their emotions. PECS can be used as a starting point to build the interactions during the instruction both between autistic students and their teachers, and between their classmates and the environment more effectively. The Picture Exchange Communication System (PECS) is a unique alternative communication intervention method for individuals with autism. It is an approach to practice communication ability using non-verbal symbols. PECS is primarily an attempt to stimulate the children's communication ability spontaneously. The use of visual language instead of verbal language is an initial mediation effort towards the communication process appears to be more complicated. The process of visual communication in turn triggers verbal expressions. PECS can be considered as efforts to provide visual stimuli. The process can be done in several phases. In the first phase the children are introduced to the non-verbal symbols. The different phases show the ability levels and the children's development. To apply PECS, it is required to use a behavior modification. By using the behavior modification, it will be covered up the children desire. The objects desired will enforce the children to communicate through the pictures exchange, in which in the final phase the use of PECS approach makes the children motivated to speak

Kodak, T., Paden, A., & Dickes, N. (2012). Training and generalization of peer-directed mands with non-vocal children with autism. *The Analysis of Verbal Behavior, 28, 119-124.*
Abstract: The current investigation evaluated the effects of extinction and prompts on training and generalization of peer-directed mands for preferred items using a picture exchange communication system with 2 children diagnosed with autism. Results showed that independent mands with a peer increased during treatment for both participants, generalized to a novel peer without explicit training for 1 participant and following training for the second participant, and maintained in a more naturalistic setting that simulated a free-play activity in a classroom. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3363405/

Koita, H. & Sonoyama, S. (2004). Communication training using the Picture Exchange Communication System (PECS): Case study of a child with autistic disorder. *Japanese Journal of Behavior Analysis, 19, 161-174.*
Abstract: The purpose of this study was to examine the effect of training with the Picture Exchange Communication System (PECS) on the acquisition of functional communication skills. Participants were a child with autism who did not speak, and his mother. Intervention was conducted with the changing conditioning design, including 6 phases and follow up. The PECS training was implemented by the participant's mother in his home. In the home, intervention was implemented using backward chaining and other methods, the child's mother taught him to give her icons in order to make requests and answer questions. Measures were the percentage of correct responses in the PECS training, the frequency of spontaneous requesting with using the PECS, and the form and the initial time of speech after the intervention has begun. As a result, the boy learned the PECS in a comparatively short period, and spontaneous requesting using the PECS increased. After the intervention, some speech appeared, but its

frequency was low. Although the PECS training could be effectively implemented by the mother in home, the procedures for commenting need to be examine further.

Koita, H., Sonoyama, S., & Takeuchi, K. (2003). Communication Training With the Picture Exchange Communication System (PECS) for Children With Autistic Disorder: The Training Program and Current and Future Research. *Japanese Journal of Behavior Analysis, 18, 120-130. (Japanese)*
Abstract: This review article would be one of the first studies to be published in Japan on the PECS. The PECS was developed by Frost and Bondy as a means to teach children with autistic disorder and related developmental disabilities a self-initiating, functional communication system that could be rapidly acquired. Its theoretical roots combine principles from applied behavior analysis and guidelines established within the field of augmentative and alternative communication. The PECS training manual was first published in 1994, and revised in 2002. In the PECS training protocol, children are taught to exchange a picture for a desired item and eventually learn to construct picture-based sentences and use a variety of attributes in their requests. The system emphasizes developing the request function prior to developing responding to simple questions and commenting. In the present article, we described the PECS procedure, summarize effects of communication training by PECS, and comment on the future of PECS.

Kravits, T. R., Kamps, D.M., & Kemmerer, K. (2002). Brief report: Increasing communication skills for an elementary-aged student with autism using the picture exchange communication system. *Journal of Autism and Developmental Disorders, 32, 225-230.*
Abstract: Communication and interactions with others are a few of the hardest tasks for an autistic child. This study showed how the gap may be bridged by using a system called the Picture Exchange Communication System (PECS). A 6-year-old girl named Molly showed much improvement in both her verbalizations and socialization skills using this method which gives promise to execution of these programs. (http://www.springerlink.com/content/104757)

Kuma, H., Takeuchi, Y., Hara, Y., Naoi, N., Yamamoto, J., Takahashi, K., Iijima, K., Saito, U., Watanabe, S., Haramaki, S., & Bondy, A. (2009). On Current Research and Practice on Autism and Communication in Japan. *Japanese Journal of Behavior Analysis, 24, 82-101.*
Abstract: The present symposium was conducted at a seminar on and communication held on July 12, 2008, at Hosei University in Tokyo. First, a comprehensive program for teaching communication skills to autistic children at Keio University was presented. Second, a family-support program provided by the University of Tsukuba to teach an autistic child using PECS at home was introduced. Third, a family and school support program based on functional communication training provided by a private clinic (TASUC Ltd.) was described. Finally, the discussant, Bondy, commented on each presentation on the basis of his expertise in providing communication training for teachers and parents working with children with autism.

Kuramitsu, A. Tyou, K. & Sonoyama, S. (2008). Shaping Mand Behavior by Home-based Communication Training Using PECS for a Child with Pervasive Developmental Disorder. *Japanese Journal of Disability Science, 32, 159-171.*
Abstract: In this study, we conducted Picture Exchange Communication System (PECS) training for one non-speaking child with pervasive developmental disorder, and examined the effect of the acquisition and expansion of functional communication skills. An ecological assessment was implemented to establish a training environment so as to encourage the child as regards mand behaviors. The mother carried out the PECS training for the child as a home trainer. For the training procedure, a series of actions required in daily life were grouped into a set of tasks by using PECS. A task analysis was conducted with mand behavior using a picture card and a sentence seat view to making each task group easy for the child to acquire. As a result the child quickly acquired mand skills with PECS. In addition, the mand skills using PECS were demonstrated to the child's father who was not a trainer, or in a non-training setting at home. It was suggested that an issue will remain related to an examination of the generalization of mand skills by PECS in a setting other than meal times at home.

Lancioni, G., O'Reilly, M., Cuvo, A., Singh, N., Sigafoos, J. & Didden, R. (2007). PECS and VOCAs to enable students with developmental disabilities to make requests: An overview of the literature. *Research in Developmental Disabilities, 28, 468-488*
Abstract: This paper provides an overview of the literature dealing with the use of the Picture Exchange Communication System (PECS) and voice output communication aids (VOCAs) for promoting the performance of requests by students with developmental disabilities. Computerized and manual searches were carried out to identify the studies published during the last 15 years (i.e., the period between 1992 and 2006 during which PECS and VOCA approaches became popular). Thirty-seven studies were identified and then divided into three groups concerning the use of the PECS or equivalents, the use of VOCAs or equivalents, and the comparison of both these approaches, respectively. Of the 173 students involved in studies using the PECS or equivalents only three could be considered failures, while a fourth one did not progress in the program due to illness. Similarly, of the 39 students who used VOCAs or equivalents only three could be considered failures, while one was partly successful. Finally, of the 11 students involved in the comparisons between PECS and VOCAs none could be classified as a failure. The results are very encouraging but methodological concerns and the relatively limited use of the systems in terms of request items and request opportunities suggest caution. Caution may also be needed in interpreting the reported similarities between the two systems in usability and effectiveness.

Landa, R, & Hanley, G. (2016). An evaluation of multiple-schedule variations to reduce high-rate requests in the picture exchange communication system. *Journal of Applied Behavior Analysis, 49, 1-6.*
Abstract: Using procedures similar to those of Tiger, Hanley, and Heal (2006), we compared two multiple-schedule variations (S+/S– and S+ only) to treat high-rate requests for edible items in the Picture Exchange Communication System (PECS). Two individuals with autism participated,

after they showed persistent requests for edible items after PECS training. Stimulus control was achieved only with the multiple schedule that involved presentation of a discriminative stimulus during reinforcement components and its removal during extinction components (S+ only). Discriminated requests were maintained for the 1 participant who experienced schedule thinning.

Ibis, J. & Reed, F. G. (2012). Modified stimulus presentation to teach simple discrimination within Picture Exchange Communication System Training. *Journal of Speech-Language Pathology and Applied Behavior Analysis, 5, 42-46.*
Abstract: Previous research has documented the effectiveness of the Picture Exchange Communication System (PECS) to teach functional communication. These studies have generally focused on evaluating the PECS curriculum as it is written, but questions regarding how best to modify stimulus materials to teach individuals with deficits in simple discrimination remain unanswered. The present study examined the effectiveness of modified stimulus presentation on the percentage of trials the preferred edible/icon was selected within a picture exchange communication training program. Using an A-B case study design, findings revealed that modified stimulus presentation improved performance above baseline levels. Performance was maintained three weeks post-training. Limitations associated with the design of this study are noted in the discussion, together with recommendations for further research.

Lerna, A., Esposito, D., Conson, M., Russo, L. & Massagli, A. (2012). Social– communicative effects of the Picture Exchange Communication System (PECS) in Autism Spectrum Disorders. *International Journal of Language and Communication Disorders, 47, 609-617.*
Abstract: The Picture Exchange Communication System (PECS) is a common treatment choice for nonverbal children with autism. However, little empirical evidence is available on the usefulness of PECS in treating social–communication impairments in autism. Aims: To test the effects of PECS on social–communicative skills in children with autism, concurrently taking into account standardized psychometric data, standardized functional assessment of adaptive behaviour, and information on social–communicative variables coded in an unstructured setting. Methods & Procedures: Eighteen preschool children (mean age = 38.78 months) were assigned to two intervention approaches, i.e. PECS and Conventional Language Therapy (CLT). Both PECS (Phases I–IV) and CLT were delivered three times per week, in 30-min sessions, for 6 months. Outcome measures were the following: Autism Diagnostic Observation Schedule (ADOS) domain scores for Communication and Reciprocal Social Interaction; Language and Personal–Social subscales of the Griffiths' Mental Developmental Scales (GMDS); Communication and Social Abilities domains of the Vineland Adaptive Behavior Scales (VABS); and several social–communicative variables coded in an unstructured setting. Outcomes & Results: Results demonstrated that the two groups did not differ at Time 1 (pre-treatment assessment), whereas at Time 2 (post-test) the PECS group showed a significant improvement with respect to the CLT group on the VABS social domain score and on almost all the social–communicative abilities coded in the unstructured setting (i.e. joint attention, request, initiation, cooperative play, but not eye contact). Conclusions & Implications: These findings

showed that PECS intervention (Phases I–IV) can improve social–communicative skills in children with autism. This improvement is especially evident in standardized measures of adaptive behaviour and measures derived from the observation of children in an unstructured setting.

Lerna, A., Esposito, D., Russo, L. & Massagli, A. (2009). The efficacy of the PECS for improving the communicative, relational and social skills in children with autistic disorder: Preliminary results. *European Psychiatry, 24, Supplement 1.*
Abstract: The aim in the current study was to investigate the efficacy of the PECS (Picture Exchange Communication System) in a sample of children with Autistic Disorder (AD) in the development of the communication, alternating gaze and pointing in children with Autistic Disorder (AD). The sample included 5 children diagnosed with AD (DSM-IV-TR), no verbal language, followed by the team of the Rehabilitation Centre belonging to Scientific Institute "E. Medea", Association "La Nostra Famiglia" Branch of Ostuni (Italy). The children were tested on their ability with neuropsychiatric, psycholinguistics and psychological assessment at the pre and post of the trial. The treatment PECS has gone on for two years with a frequency of three times a week (45 minutes each one). The results show a significant increase in the number of spontaneous requests, in the capacity of alternating gaze, pointing, vocalizing and verbalizing on imitation. Finally the PECS seems to allow not only to develop a functional communication in AD, but also to increase social communicative behaviors of children with AD. Nevertheless further studies are necessary.

Liddle, K. (2001). Implementing the Picture Exchange Communication System (PECS). *International Journal of Language and Communication Disorders, 36, 391-395.*
Abstract: PECS was developed in Delaware, USA over 10 years ago by Bondy and Frost (1994a). Over the last two years PECS has been introduced to this country and has raised a great deal of interest in people working in the field of autistic spectrum disorders (ASD). This paper will address some of the issues that arose during the establishment of PECS in one special school. Changes seen in 21 children with severe learning difficulties who have been taught to use PECS are reported and the use of PECS with children who do not have an ASD is discussed. (http://www.tandf.co.uk/journals)

Lund, S.K. & Troha, J.M. (2007). Teaching Young People who are Blind and have Autism to Make Requests Using a Variation on the Picture Exchange Communication System with Tactile Symbols: A Preliminary Investigation. *Journal of Autism Developmental Disorders, 38, 719-730.*
Abstract: This study used a single-subject multiple baseline across participants design to evaluate the effectiveness of a modified picture exchange communication system (PECS) teaching protocol with tactile symbols. Three students (two male, one female) aged 12-17 years who had autism and were blind participated in the study. The instructional program involved three phases. First, each participant learned to exchange a tactile symbol with his/her communication partner to request a preferred item/activity. Second, the distance between the communication partner and the participant was increased. Third, the participants were

required to discriminate between two dissimilar tactile symbols. One out of three participants completed all phases of the instructional program. Although the other two participants did not complete the program, they demonstrated improvement from baseline responding rates. This study provided preliminary results that using tactile symbols with strategies from PECS may be an effective method to teach requesting to youth who are blind and have autism.

Magiati, I. & Howlin, P. (2003). A pilot evaluation study of the Picture Exchange Communication System (PECS) for children with autistic spectrum disorders. *The International Journal of Autism, 7(3): 297-320.*
Abstract: A pilot study was conducted to evaluate the effects of training teachers of children with autistic spectrum disorders (ASDs) in the use of the Picture Exchange Communication System (PECS). Thirty-four children with ASDs (29 boys and 5 girls) were selected from eight specialist schools. Teaching staff attended a 2 day PECS workshop and received six half-day visits from PECS consultants. Data on the children's use of PECS, spontaneous communication, and adaptive behaviour were collected before the study and at set times following the workshop. Significant, rapid increases were recorded in the level of PECS attained by the children, in their PECS vocabulary, and in their frequency of PECS use over time. Improvements in children's general level of communication were slower to occur. The majority of participants showed improvements in their ability to use PECS. The results are discussed in relation to the methodological and practical difficulties that arose during the project.
(http://www.sagepub.co.uk/home.nav)

Maglione, M., Gans, D., Das, L., Timbie, J. & Kasari, C. (2012). Nonmedical interventions for children with ASD: Recommended guidelines and further research needs. *Pediatrics, 130, 169-178.*
Abstract: OBJECTIVE: To use the findings of a systematic review of scientific evidence to develop consensus guidelines on nonmedical interventions that address cognitive function and core deficits in children with autism spectrum disorders (ASDs) and to recommend priorities for future research. METHODS: The guidelines were developed by a Technical Expert Panel (TEP) consisting of practitioners, researchers, and parents. A systematic overview of research findings was presented to the TEP; guideline statements were drafted, discussed, debated, edited, reassessed, and presented for formal voting. RESULTS: The strength of evidence of efficacy varied by intervention type from insufficient to moderate. There was some evidence that greater intensity of treatment (hours per week) and greater duration (in months) led to better outcomes. The TEP agreed that children with ASD should have access to at least 25 hours per week of comprehensive intervention to address social communication, language, play skills, and maladaptive behavior. They agreed that applied behavioral analysis, integrated behavioral/developmental programs, the Picture Exchange Communication System, and various social skills interventions have shown efficacy. Based on identified gaps, they recommend that future research focus on assessment and monitoring of outcomes, addressing the needs of pre/nonverbal children and adolescents, and identifying the most effective strategies, dose, and duration to improve specific core deficits. CONCLUSIONS: The creation of treatment

guidelines and recommendations for future research represents an effort by leading experts to improve access to services for children with ASDs while acknowledging that the research evidence has many gaps. There is scientific evidence (from controlled trials and observational studies) of the effectiveness of the Picture Exchange Communication System (PECS) in increasing child-to-adult initiated communication, primarily requesting communication acts. Studies range in length from 3 months to 2 years. At least half the studies did not report intensity; in the studies that did report intensity, intensity ranged from 20 minutes, 3 times per week, to a total of 15 hours per week. Guideline: Individuals with ASDs who have limited verbal language, or those who do not respond to multiple interventions aimed at improving communication, should be offered the opportunity to use the PECS. Monitoring and ongoing intervention are recommended to maintain gains in communication. Rating: B (80%) (http://pediatrics.aappublications.org/content/130/Supplement_2/S169.full.pdf+html)

Marckel, J.M, Neef, N.A. & Ferreri, S.J. (2006). A preliminary analysis of teaching improvisation with the picture exchange communication system to children with autism. *Journal of Applied Behavior Analysis, 39, 109-115.*
Abstract: Two young boys with autism who used the picture exchange communication system were taught to solve problems (improvise) by using descriptors (functions, colors, and shapes) to request desired items for which specific pictures were unavailable. The results of a multiple baseline across descriptors showed that training increased the number of improvised requests, and that these skills generalized to novel items, and across settings and listeners in the natural environment.

Martocchio, N. & Rosales, R. (2016). An Evaluation of Pyramidal Training to Teach Implementation of the Picture Exchange Communication System: Pyramidal training PECS. *Behavioral Interventions, 31, 265-282.*
Abstract: The pyramidal training or train-the-trainer model is a method of training in which a professional teaches a skill to a small group of individuals who then teach that skill to another set of individuals. This model has demonstrated efficacy to teach several behavioral intervention techniques to parents, teachers, and direct care staff in a timely manner. The purpose of the present study was to extend the literature on pyramidal training to teach implementation of the first four phases of the Picture Exchange Communication System (PECS) to university students working with a confederate learner. We used a multiple baseline across participants design (Tier 1 and 2) and a non-concurrent multiple baseline design (Tier 3) to demonstrate the efficacy of this model. Results replicate and extend the literature on pyramidal training. Discussion focuses on implications and limitations to be addressed in future work.

McCleery, J. (2015). Comment on technology-based intervention research for individuals on the autism spectrum. *Journal of Autism and Developmental Disorders, 45, 3832-3835.*
Abstract: The purpose of this letter to the editor is to comment on several review papers recently published in the current Journal of Autism and Developmental Disorders, Special Issue on Technology: Software, Robotics, and Translational Science. These reviews address a variety

of aspects relating to technology-aided intervention and instruction for individuals with Autism Spectrum Disorders (ASDs). Here, I comment on and evaluate the overall status of research and development in this area, including reflection on current challenges in this area in the context of previous challenges and resolutions in behavioral intervention research. From these reviews and the current evaluation, I further discuss important next steps for the field which may be critical for guiding progress toward meaningful impacts upon individuals with ASD.

McCleery, J., Elliott, N., Sampanis, D. & Stefanidou, C. (2013). Motor development and motor resonance difficulties in autism: relevance to early intervention for language and communication skills. *Frontiers in Integrative Neuroscience, 7,1-20.*
Abstract: Research suggests that a sub-set of children with autism experience notable difficulties and delays in motor skills development, and that a large percentage of children with autism experience deficits in motor resonance. These motor-related deficiencies, which evidence suggests are present from a very early age, are likely to negatively affect social-communicative and language development in this population. Here, we review evidence for delayed, impaired, and atypical motor development in infants and children with autism. We then carefully review and examine the current language and communication-based intervention research that is relevant to motor and motor resonance (i.e., neural "mirroring" mechanisms activated when we observe the actions of others) deficits in children with autism. Finally, we describe research needs and future directions and developments for early interventions aimed at addressing the speech/language and social-communication development difficulties in autism from a motor-related perspective.

McCoy, A. & McNaughton, D. (2018). Training education professionals to use the Picture Exchange Communication System: a Review of the literature *Behavior Analysis in Practice, 11*, 1-10. **https://doi.org/10.1007/s40617-018-00296-4**
Abstract: The Picture Exchange Communication System (PECS) is a popular augmentative and alternative communication strategy. Like many communication interventions, the successful use of PECS is dependent on the skills of the communication partner. This article provides a systematic review of the published research on teaching education professionals (EPs) to use PECS. Training of EPs was usually conducted during individual or small group sessions and included a description of the PECS strategy, practice on implementation of PECS, and feedback on performance. Instructional activities typically resulted in an immediate increase in the quality and/or quantity of PECS opportunities provided by the EP; however, mixed findings are reported for maintenance and generalization. Implications for future research and practice are discussed.

McDonald, M., Battaglia, D. & Keane, M. (2015). Using fixed interval-based prompting to increase a student's initiation of the Picture Exchange Communication System. *Behavioral Development Bulletin, Oct 5.*
Abstract: This report describes an AB case study in which a fixed interval-based prompting procedure was used to support a child's spontaneous approach to a Picture Exchange

Communication System (PECS) book for selecting icons to request preferred items. The participant was a 6-year-old student with autism spectrum disorder. Preferred items were determined through formal preference assessments prior to the onset of the study. Performance was monitored based on the percentage of spontaneous approaching and requesting behaviors emitted during 10-min intervals throughout each day. Results revealed an increase in requesting of preferred items from a mean of 12% during baseline to 43% during intervention and 83% at a 6-month follow-up.

Mirenda, P. (2003). Toward functional augmentative and alternative communication for students with autism: Manual signs, graphic symbols, and voice output communication aids. *Language, Speech, and Hearing Services in Schools, 34, 203-216.*
Abstract: Many individuals with autism are candidates for augmentative and alternative communication (AAC) systems, either to supplement (i.e., augment) their existing speech or to act as their primary (i.e., alternative) method of expressive communication. The purpose of this article is to summarize research and directions for future research with regard to two questions related to the delivery of AAC supports to these individuals: (a) What AAC modality is preferable to use? And (b) What do we know about the use of voice output communication aids with people with autism? (http://www.asha.org)

Montanari, S. Using picture exchange communication system with autistic children in a day hospital: two years after training. *Perspectives Psychology, OCT/DEC., 1-8. (France)*
Abstract: Introduction: We had realized a study two years previously concerning the evaluation of the skills in communication of five autistic children during their learning of the picture exchange communication system.
Objective: We suggest here reporting the evolution of these five children two years after the formation and to review the use of this method. Material and method: We proceeded to conversations semi-structured with nursing concerning the clinical evolution of the children, their progress from the point of view of the communication as well as on the use which was made by the picture communication system at the day hospital. Results: On five children of the initial search, three of them don't use the picture exchange communication system anymore. For the two other children, the use of the picture exchange communication system continues but without emergence of verbal language or other visible progress on the big functions of communication. The picture exchange communication system is especially used on the groups of life and at the lunch time, the session of learning being difficult to set up. Conclusion: The picture exchange communication system seems to constitute a foot adapted to the difficulties of representation and abstraction of the autistic children. However, the children who use perfectly the method but do not reach the verbal language shows its limits and the necessity of experimenting other approaches.

Montanari, S., Vandromme, L. & Perot, JM. (2015). *Perspective Psychology, Jul/Sep., 1-9. (France).*
Abstract: Introduction Among the interventions focused on the communication for the autistic children, the Picture Exchange Communication System seems to lack the support of numerous institutions and speech therapists although few fundamental studies and case studies really show its efficiency. Within the framework of the introduction of the Picture Exchange Communication System in a day hospital in Picardy, we were able to follow the implementation of this method. Objective: We wished to study the contributions of this new method on the skills in communication of five autistic children. Method: We estimated the skills in communication of these five children thanks to the M Guidetti and C Tourette's Early Social Communication Scale and to the Schopler's Childhood Autism Rating Scale at six months interval. Results: Our results show progress for five children as regards the level of Picture Exchange Communication System. Besides, we note a preservation or a progress in the results in the early Social Communication Scale for five children. The observed progress concerns three domains of the seule (social interaction, joint attention and regulation of the behavior). Conclusion: This preliminary study could be widened in a research on several day hospitals and pursued over time to evaluate if the use of the Picture Exchange Communication System indeed has a long-term interest for the children.

Nam, S. & Hwang, Y. (2016). Acquisition of Picture Exchange-Based vs. Signed Mands and Implications to Teach Functional Communication Skills to Children with Autism. *Journal of Special Education Apprenticeship, 5, 1-15*
Abstract: A literature review was conducted to describe important concepts involved in functional analysis of verbal behavior as well as to evaluates empirical research findings on acquisition of picture exchange-based vs. signed mands to suggest instructional implications for teachers and therapists to teach functional communication skills to children with autism. Research findings indicate that children with autism acquire picture exchange responses to mand for reinforcing items more easily and rapidly than signed responses. There is also a strong relation between motor imitation, matching skills and sign language acquisition. It is suggested that both motor imitation and matching skills be examined to teach manual signs to children with autism. Speech is the most common response form, but writing, typing, signs, pictures, gestures, or eye gaze should also be considered for manding. A decision making process is proposed to determine a proper communicative form considering abilities and environmental conditions of a child concerned.

Ninci, J., Rispoli, M., Neely, L. & Guz, S. (2018). Transferring picture exchange requests to receptive identification for children with ASD. *Developmental Neurorehabilitation, 21,* 178-187.
Abstract: The purpose of this study was to evaluate a procedure to transfer stimulus control from picture exchange requests to receptive identification. Three children with autism spectrum disorder (ASD) and absent receptive identification repertoires participated. An adapted alternating treatment design was used. During intervention, two high-preferred and two low-preferred targets were available during picture exchange requesting sessions.

Participants requested primarily for one or both high-preferred targets. During receptive identification instructional sessions, one participant acquired one high-preferred target, one participant acquired all targets, and one participant demonstrated no improvements. Generalization to novel examples of targets was assessed pre- and post-intervention and programmed if necessary. One participant generalized his acquired high-preferred target without programming. Another participant generalized a high-preferred and a low-preferred target without programming and acquired a high-preferred target with programming. Potential benefits of this intervention and suggestions for future research are presented.

Ogletree, B., Morrow-Odom, K.L. & Westling, D. (2013). Understanding the brain-behaviour relationship in persons with ASD: Implications for PECS as a treatment choice. *Developmental Neurorehabilitation, early online, 1-9.*
Abstract: This article presents emerging neurological findings in Autism Spectrum Disorders (ASD) with particular attention to how this information might inform treatment practices addressing communication impairments. Methods: The article begins with a general discussion of the brain–behaviour relationship and moves to the presentation of recent research findings related to ASD. There is particular attention to individuals with autism who are either nonverbal or present emergent verbal abilities. Results/Discussion: A specific communication treatment, the Picture Exchange Communication System (PECS), is presented as an example of an intervention that addresses the learner needs of many individuals with ASD. The success of PECS is discussed within the context of its fit with brain-based learner characteristics.

Okalidou, A., & Malandraki, G. (2007). The application of PECS in children with autism and deafness: A case study. *Focus on Autism and Other Developmental Disabilities, 22, 23-32.*
Abstract: The subject of this study is a 10-year-old non-verbal Greek boy, who has been diagnosed with both bilateral sensory-neural profound hearing loss and autism. The Picture Exchange Communication System (PECS), with some modifications and extensions, was applied for a 4-month intensive intervention period. His original communication and behavioral status as well as the PECS application process are presented along with the communicative, language and psychosocial outcomes following the entire intervention program. In addition, follow-up data are presented six months post-intervention.

Ostryn, C., Wolfe, P. & Rusch, F. (2008). A Review and Analysis of the Picture Exchange Communication System (PECS) for Individuals with Autism Spectrum Disorders Using a Paradigm of Communication Competence. *Research & Practice for Persons with Severe Disabilities, 33, 13–24.*
Abstract: Research related to the use of the Picture Exchange Communication System (PECS) with individuals having autism spectrum disorders (ASDs) was examined using a communication competence paradigm detailed by J. C. Light (1988, 1989, 2003). Communication components were operationalized based on skills identified in ASD research. A review was conducted to examine general PECS outcomes and outcomes related to communication competence including generalized, spontaneous, and joint attention abilities, and maintenance. Results

indicated that there were few empirical studies related to the PECS. Of note, the reported studies indicated generally positive outcomes for individuals with ASDs, particularly related to manding and generalization. When the communication competence paradigm was applied, results indicated that, in its present form, the PECS needs to be used as a part of a multimodal communication system. Results suggest that training related to the PECS includes joint attention and question asking. Recommendations for the use of PECS and future research with individuals having ASDs are outlined.

Overcash, A., Horton, C. & Bondy, A. (2010). The Picture Exchange Communication System: Helping individuals gain functional communication. *Autism Advocate, 3, 21-24. Implementing PECS in the home, community and generalizing PECS across settings and people.*

Paden, A., Kodak, T. Fisher, W., Gawley-Bullington, E. & Bouxsein, K. (2012). Teaching children with autism to engage in peer-directed mands using a picture exchange communication system. *Journal of Applied Behavior Analysis, 45, 425-429.*
Abstract: We evaluated differential reinforcement of alternative behavior (DRA) plus prompting to increase peer-directed mands for preferred items using a picture exchange communication system (PECS). Two nonvocal individuals with autism participated. Independent mands with a peer increased with the implementation of DRA plus prompting for both participants. In addition, peers engaged in brief social interactions following the majority of mands for leisure items. These results suggest that teaching children to use PECS with peers may be one way to increase manding and social interactions in individuals with limited or no vocal repertoire.

Park, J.H. (2009). The effects of mother-implemented Picture Exchange Communication System training on spontaneous communicative behaviors of young children with autism spectrum disorders. *Doctoral Dissertation, Ohio State University.*
Abstract: The current study examined whether mothers could be taught to implement the picture exchange communication system (PECS) training with their child and investigated the effects of the mother-implemented PECS training on the spontaneous communication of young children with autism spectrum disorders. Three mothers were trained to teach their child PECS Phases 1 through 3B and subsequently were asked to train their child to use PECS as a way of requesting a preferred item or activity. Results on mother's accuracy of implementing PECS training showed that all three mothers taught their child PECS with high integrity. A changing criterion design was used to demonstrate the effects of mother-implemented PECS training on children. Results indicated that all three children successfully acquired independent picture exchanges along with the mother-implemented PECS training. Moreover, not only did all three children generalize PECS skills to an untrained communication partner, they also maintained the acquired skills over one month. Word vocalizations increased for one child, though no or limited improvement was observed for the other two. These findings extend the existing evidence on PECS by training mothers as primary implementers of PECS training and provide practitioners with insight into the feasibility and necessity of parent-implemented PECS training.

Park, J.H., Alber-Morgan, S. & Cannella-Malone, H., (2011). Effects of Mother-Implemented Picture Exchange Communication System (PECS) Training on Independent Communicative Behaviors of Young Children With Autism Spectrum Disorders *Topics in Early Childhood Special Education, 31, 37-47.*
Abstract: This study examined the effects of mother-implemented Picture Exchange Communication System (PECS) training on the independent communication of three young children with autism spectrum disorders. Three mothers were trained to teach their child PECS Phases 1 through 3B, which they did with high integrity. Moreover, all three children successfully acquired independent picture exchanges that were generalized to a different communication partner and maintained for at least 1 month. Vocalizations across participants showed limited or no improvement. These findings systematically extend previous PECS research by training mothers to be the primary implementers of PECS training. In addition, this research provides practitioners with insight into the feasibility and necessity of parent-implemented PECS training.

Parker, A.T. (2009). Measuring an adapted form of Picture Exchange Communication System (PECS) for young children with visual impairments and developmental disabilities. *Doctoral Dissertation, Texas Tech University.*
Abstract: The Picture Exchange Communication System (PECS) has been shown to build the expressive communication skills for students with autism and those with developmental disabilities. Traditional PECS teaching strategies rely upon an intact visual sense for accessing pictures, line drawings, gestures or other visual supports from a communication partner to request items, or make choices about desired objects in the environment. The use of 3-D parts of objects may be useful in adapting the PECS protocol for individuals with visual impairments and additional disabilities. This study examined the effects of an adapted form of PECS on the communication skills for three students with visual impairments and developmental delays.

Pasco, G. & Tohill, C. (2011). Predicting progress in Picture Exchange Communication System (PECS) use by children with autism. *International Journal of Language and Communication Disorders, 46, 120-125.*
Abstract: Background:The Picture Exchange Communication System(PECS) is a widely used communication intervention for non-verbal children with autism spectrum disorder. Findings for the benefits of PECS have almost universally been positive, although there is very limited information about the characteristics of PECS users that determine the amount of progress that they are likely to make. Aims: To explore the utility of using children's developmental age to predict the subsequent degree of progress using PECS. Methods & Procedures: In a retrospective study, 23 non-verbal 5- and 6-year-old children with autism spectrum disorder attending a special school were assessed to determine their highest level of PECS ability. They were then allocated to one of two groups depending on whether or not they had mastered PECS phase III. All participants had been assessed using the Psycho-Educational Profile—Revised (PEP-R) on entry to the school and before being introduced to PECS. Total

developmental age scores were examined to determine whether they accurately predicted membership of the two PECS ability groups. Outcomes & Results: All the 16 children who had mastered PECS phase III had total developmental age scores of 16 months or above, whilst six of the seven children who had not progressed beyond phase III scored below 16 months—the other child had a score of 16 months. Conclusions & Implications: The assessment of the developmental level of potential PECS users may provide valuable predictive information for speech-and-language therapists and other professionals in relation to the likely degree of progress and in setting realistic and achievable targets.

Peirats-Chacón, J. & Vidal-Esteve, I. (2016). Introducing PECS to overcome the communicative limitations in a case of West syndrome, *Journal of Psychology, 34, 71-80. (Spain)*
Abstract: This case study tackles the intervention in a four year-old student schooled in a specific class at an ordinary school who was recently diagnosed with West syndrome. Applying during a quarter in a Hearing and Speech classroom The Picture Exchange Communication System (PECS) was applied over a period of an academic quarter in the school's Hearing and Speech classroom with the goal of helping the student overcome the serious communicative limitations associated with the syndrome. A mixed methodological procedure is used, with research techniques consisting of the application of standardized tests, interviews, questionnaires, observations, records and document analysis. From the initial assessment of the case, established by the test, the program is implemented and data are recorded daily, in addition to interviewing the family and analysing documents and questionnaires filled out by the teachers involved. The results show that while the reluctance of some teachers suggests the need to improve coordination, this wasn't an obstacle to the achievement of certain benefits in terms of student interaction, request and eye contact, essential for communicative achievement.

Peterson, S., Bondy, A., Glassberg, M. & Neef, N. (2002, May). The relationship of match-Ogelto-sample to visual discrimination skills utilized within PECS. *Paper presented at the Annual Association for Behavior Analysis Convention, Toronto, CA.*

Peterson, S., Bondy, A., Vincent, Y. & Finnegan, C. (1995). Effects of alternating communicative input for students with autism and no speech: Two case studies. *Augmentative and Alternative Communication, 11, 93-100.*
Abstract: Individuals with autism and severe mental retardation typically display deficits in both communicative input and communicative output skills. Comprehension of spoken input may be particularly challenging for individuals with autism, for a number of reasons. This paper presents two case studies examining the impact of varying the form of communicative input on behavior management targets as well as performance on an object identification task. Both cases involved students with autism and no speech. One student responded with poor task performance and high frequencies of self-injury to spoken communication but not to gestures alone or gestural plus spoken communication. The other student displayed a similar pattern of task performance and showed an increased tendency toward disruptive behavior in response to

spoken or spoken plus gestural communication only in high-stress situations. Program modifications (changes in the communication approaches of these students' communicative partners) are described. It is suggested that the impact of spoken communicative input on task performance and behavior management targets of individuals with autism be probed in cases where more straightforward programming issues have been addressed with only limited success.

Peterson, S., Glassberg, M., Neef, N. & Bondy, A. (2002, May). PECS acquisition: Patterns of skill development across four young children. *Paper presented at the Annual Association for Behavior Analysis Convention, Toronto, CA.*

Preissler, M.A. (2008). Associative learning of pictures and words by low-functioning children with autism. *Autism, 12, 231-248.*
Abstract: This research investigates whether children with autism learn picture, word and object relations as associative pairs or whether they understand such relations as referential. In Experiment 1, children were taught a new word (e.g. 'whisk') repeatedly paired with a novel picture. When given the picture and a previously unseen real whisk and asked to indicate a whisk, children with autism, unlike typically developing peers matched on receptive language, associated the word with the picture rather than the object. Subsequent experiments respectively confirmed that neither a bias for selecting pictures nor perseverative responding accounted for these results. Taken together, these results suggest that children with autism with cognitive difficulties are learning picture–word and picture–object relations via an associative mechanism and have difficulty understanding the symbolic nature of pictures.

Preston, D, & Carter, M. (2009). A review of the efficacy of the Picture Exchange Communication System Intervention. *Journal of Autism and Developmental Disabilities, 39, 1471-1486.*
Abstract: The Picture Exchange Communication System (PECS) is a communication program that has become widely used, especially with children with autism. This paper reports the results of a review of the empirical literature on PECS. A descriptive review is provided of the 27 studies identified, which included randomized controlled trials (RCTs), other group designs and single subject studies. For 10 appropriate single subject designs the percentage of non-overlapping data (PND) and percentage exceeding median (PEM) metrics were examined. While there are few RCTs, on balance, available research provides preliminary evidence that PECS is readily learned by most participants and provides a means of communication for individuals with little or no functional speech. Very limited data suggest some positive effect on both social communicative and challenging behaviors, while effects on speech development remain unclear. Directions for future research are discussed including the priority need for further well-conducted RCTs.

Putri, C., Hastuti, W. & Adi, E. (2018). The influence the Picture Exchange Communication System method toward the communication ability of Autistic child, *Journal of ICSAR, 2*, 1-6. [Indonesia]
Abstract: Children with autism have some very complex developmental disorders including communication, social interaction, emotions, and interest in certain behaviors. They need certain tools and methods for developing communication and language skills, especially in speaking skills. One of the methods is the Picture Exchange Communication System method. This research was conducted by using the Single Subject Research method with A-B-A design. Data collection was conducted in 20 sessions. The results of this study indicated that the effect of PECS method towards communication ability of children with autism. This was evidenced by an overlap percentage of 0%. The conclusion showed that PECS method has an effect towards the communication ability of autistic children.

Rahman, F., Kayani, A. & Hanif, M. (2019). Digital embodiment of adapted version of the Picture Exchange Communication System (PECS) for autistic children in Pakistan. *Academic Research International*, 10, 101-105.
Abstract: In 1984 Lori Frost and Dr. Andrew Bondy developed PECS. PECS basically aids autistic people in developing verbal language; moreover, it reduces grumpiness and anomalous behaviors which results in increased socialization. By implementing the heuristic framework, the researcher adapted pictures which were traditionally sensitive for Pakistan within the PECS. The current experimental research aimed to utilize digital advancements for implementing the adapted version of PECS for autistic children in Pakistan to facilitate their communication and personification in the world. An experimental study on a sample of 5 autistic children was conducted for the digital embodiment of adapted PECS. The sample of the research study comprised of one experimental group. Convenience sampling technique was administered in order to make the precise and accurate results. A paired t-test on sample and digital adapted PECS showed significant results. Statistical package for social sciences (SPSS Version, 22.0) for data analysis. As the study was experimental, so the main objective of the study was to highlight the effectiveness and implementation of digital embodiment of adapted pictures within the PECS. This study has produced a well-adapted digitally embodied PECS, suitable for implementation for Pakistani Autistic Children. Results of this study confirmed that digital embodiment of adapted PECS enhanced the perceptual and sensory skills of the autistic children. The high level of correct identification percentage of adapted PECS through ipad, depicts that no response percentage was lesser in digitally adapted PECS as compared to the adapted PECS on hard copy.

Rahman, F., Najmussaqib, A. & Kiani, A. (2016), Adaption of Picture Exchange Communication System (PECS) for children with autism spectrum disorder: A case study of Pakistan. *Science International, 28, 451-454. (Pakistan).*
Abstract: Management of Autism has been the subject of much academic research around the globe in recent times. Autism affects the child's communication, socialization and cognition. From many decades Picture Exchange Communication System (PECS) has been successfully

used for autistic children and evidenced significant positive results respectively. The present study was aimed at exploring the awareness of the application of this system for autistic children, to check the cultural appropriateness and comprehensibility of (PECS) in Pakistan. For this purpose, a questionnaire and a focus group discussion was conducted with 150 participants from special education institutions of five provinces i.e. Punjab, Baluchistan, Sindh, Khyberpakhtunkha and Azad Jammu Kashmir of Pakistan. Results indicated that 50% of the participants are not aware of the system. Results also showed that there is a 100% need to adapt this system in Urdu language. Results are discussed in a cultural context proposing a need for the adaptation of PECS for children with autism spectrum disorder in Pakistan.

Rauch, J., McLaughlin, T., Derby, K.M. & Rinaldi, L., (2012). Teaching a Non-Verbal Preschool Student to Use a Modified Picture Exchange Communication System: Effects of Fading Prompts on Rate of Communication and Generalization to a Communication Board. *International Journal of Basic and Applied Science, 1, 320-330.*
Abstract: The purpose of this study was to evaluate the effects of a Picture Exchange Communication System (PECS) and fading prompts to increase rate of communication and to teach generalization to a full communication board. One non-verbal preschool student with multiple developmental delays served as our participant. A combination ABCDEF single case and multiple baseline experimental design was used. A refers to baseline or no intervention and the additional letters evaluate the various interventions that were employed. This study demonstrated that PECs and fading prompts was shown to be responsible for increasing both spontaneous, independent communication and correct responses.
(http://www.insikapub.com/Vol-01/No-02/19IJBAS%281%29%282%29.pdf)

Rehfeldt, R. & Root, S. (2005). Establishing derived requesting skills in adults with severe developmental disabilities. *Journal of Applied Behavior Analysis, 38, 101-105.*
Abstract: This project examined whether a history of reinforced relational responding would result in derived requesting skills in three adults with disabilities. Participants were first taught to request preferred items using pictures [with PECS]; they were then taught conditional discriminations between pictures and their dictated names and dictated names and their corresponding text. Finally, requests for preferred items using corresponding text were evaluated. All three participants demonstrated derived requesting skills.

Rosales, R. & Rehfeldt, R.A. (2007). Contriving transitive conditioned establishing operations to establish derived manding skills in adults with severe developmental disabilities. *Journal of Applied Behavior Analysis, 40, 105-121.*
Abstract: The purpose of this study was to demonstrate derived manding skills in 2 adults with severe developmental disabilities and language deficits by contriving transitive conditioned establishing operations. Specifically, we evaluated whether a history of reinforced conditional discrimination learning would ultimately result in a derived mand repertoire, in which participants manded for items that were needed to complete chained tasks. After mastering the first three phases of the picture exchange communication system (PECS), participants were

taught to mand for the needed items by exchanging pictures of the items for the items themselves. They were then taught to conditionally relate the dictated names of the items to the corresponding pictures of the items and to relate the dictated names to the corresponding printed words. We then tested, in the absence of reinforcement, whether participants would mand for the items needed to complete the chained tasks using text rather than pictures. Both participants showed the emergence of derived mands and some derived stimulus relations as a result of this instruction. Some of the derived relations were shown to be intact at 1-month follow-up, and scores on derived mand probes were higher at follow-up than before training. In addition, the 2 participants vocally requested the needed items on maintenance test probes, a skill that was never trained and was not previously in their repertoires. These results suggest that a history of reinforced relational responding may facilitate the expansion of a number of verbal skills and emphasize the possibility of a synthesis of Skinner's (1957) analysis of verbal behavior and derived stimulus relations into language-training efforts for persons with significant disabilities.

Rosales, R., Stone, K. & Rehfeldt, R. A. (2009). The effects of Behavioral Skills Training on the implementation of the Picture Exchange Communication System. *Journal of Applied Behavior Analysis, 42, 541-9.*
Abstract: The effectiveness of a behavioral skills training (BST) package to teach the implementation of the first three phases of the Picture Exchange Communication System (PECS) was evaluated with three adults who had no history teaching any functional communication system. A multiple baseline across participants design was used to evaluate the effectiveness of the training package, which consisted of a video, written and verbal instructions, modeling, rehearsal, and feedback. Results showed significant improvements relative to baseline in a short amount of training time, and that skills generalized to a learner with a severe developmental disability. Skills were maintained at one-month follow-up for one participant.

Schreibman, L. & Stahmer, A. (2014). A randomized trial comparison of the effects of verbal and pictorial naturalistic communication strategies on spoken language for young children with autism. *Journal of Autism and Developmental Disorders, 44, 1244-1251.*
Abstract: Presently there is no consensus on the specific behavioral treatment of choice for targeting language in young nonverbal children with autism. This randomized clinical trial compared the effectiveness of a verbally-based intervention, Pivotal Response Training (PRT) to a pictorially-based behavioral intervention, the Picture Exchange Communication System (PECS) on the acquisition of spoken language by young (2–4 years), nonverbal or minimally verbal (≤9 words) children with autism. Thirty-nine children were randomly assigned to either the PRT or PECS condition. Participants received on average 247 h of intervention across 23 weeks. Dependent measures included overall communication, expressive vocabulary, pictorial communication and parent satisfaction. Children in both intervention groups demonstrated increases in spoken language skills, with no significant difference between the two conditions. Seventy-eight percent of all children exited the program with more than 10 functional words.

Parents were very satisfied with both programs but indicated PECS was more difficult to implement.

Schreibman, L. & Stahmer, A. C. (2013). A Randomized Trial Comparison of the Effects of Verbal and Pictorial Naturalistic Communication Strategies on Spoken Language for Young Children with Autism. *Journal of Autism and Developmental Disabilities, DOI 10.1007/s10803013-1972-y*

Abstract: Presently there is no consensus on the specific behavioral treatment of choice for targeting language in young nonverbal children with autism. This randomized clinical trial compared the effectiveness of a verbally-based intervention, Pivotal Response Training (PRT) to a pictorially-based behavioral intervention, the Picture Exchange Communication System (PECS) on the acquisition of spoken language by young (2–4 years), nonverbal or minimally verbal (B9 words) children with autism. Thirty-nine children were randomly assigned to either the PRT or PECS condition. Participants received on average 247 h of intervention across 23 weeks. Dependent measures included overall communication, expressive vocabulary, pictorial communication and parent satisfaction. Children in both intervention groups demonstrated increases in spoken language skills, with no significant difference between the two conditions. Seventy-eight percent of all children exited the program with more than 10 functional words. Parents were very satisfied with both programs but indicated PECS was more difficult to implement.

NOTE: Words produced (MacArthur CDI raw number of words)

Pretreatment	Post Treatment (6 mn)	Follow-up (3+ mn)
PECS 5.3	88.7	129.8
PRT 11.9	113.3	
83.2		

Both groups showed substantial increases in spoken word production for children with ASD with 10 or fewer spoken words at the start of training.

Schreibman, L. (2008). One Size Does Not Fit All: Developing individualized treatment protocols for children with autism. *The Association for Behavior Analysis Newsletter, 31 (3), 40-43.*

Schwartz, I. S., Garfinkle, A. N., & Bauer, J. (1998). Communicative outcomes for young children with disabilities. *Topics in Early Childhood Special Education, 18, 144–159.*

Abstract: The Picture Exchange Communication System (PECS) has become a widely known and used augmentative system for teaching functional communication skills and potentially providing a bridge to speech acquisition. Unfortunately, although there is a great deal of anecdotal clinical evidence about the PECS, there is little empirical information about its efficacy. We present two studies documenting the use of PECS for preschool children with

severe disabilities. The first study analyzed the PECS acquisition data for 31 preschool children and demonstrated that young children with severe communication delays and disorders can learn to use PECS quickly and efficiently. The second study followed 18 preschool PECS users for a year. The results of language samples taken at snack time and during free-choice activities indicated that PECS use generalizes to untrained settings and may have concomitant effects on untrained language functions. Directions for future research are discussed. (http://www.proedinc.com)

Schwartz, J. & Nye, C. (2006). Improving Communication for Children with Autism: Does Sign Language Work? *Evidence Based Practice Briefs, 1,1-17.*
Summary: This review spotlights the glaring shortage of high quality research needed to inform any discussion of the merits of teaching sign language to children with autism. In the intervening 18 years since Yoder and Layton (1988) called for experimental research on this topic, little appears to have been accomplished. Thus, clinicians' use of a sign language approach to enhance the communicative competence of children with autism must be considered in light of (a) the absence of conclusive group experimental design evidence to corroborate the single subject design findings, and (b) the absence of a discussion of intervention fidelity in all studies reviewed. From a programmatic and policy implementation point of view, the single subject research offers limited support for the use of sign language for children with autism. Considering the overall quality of the available research we would suggest that there are insufficient data to advocate for the use of sign language either alone on in combination with oral language as a method for substantially improving communication in children with autism. Evidence-Based Practice Recommendation: Evidence-based practice requires clinicians to integrate the scientific, objective, and quantifiable data available in the research literature into the clinical decision-making process. Evidence-based practice should allow professionals to consider a variety of sources of information in light of the client's needs and the situation of the individual being treated. In this review, the evidence on the use of sign language with children with autism provides limited support for its concentrated application for children with autism, as there is little compelling evidence that sign language provides substantial improvements in either oral or sign language communication. The modest effects reported by single subject studies coupled with the absence of even a few well controlled group studies only serves to suggest that either (a) the research community views this area of intervention as having limited usefulness, or (b) the clinical community has not found sign language to be of a substantial a value so as to press for more and better research. This review indicates that there is a need for high quality primary research that will provide the scientific basis for the effective clinical application of sign language intervention for children with autism.

Sigafoos, J., Ganz, J., O'Reilly, M., Lancioni, G., & Schlosser, R. (2007). Assessing correspondence following acquisition of an exchange-based communication system. *Research in Developmental Disabilities, 28, 71–83.*
Abstract: Two students with developmental disabilities were taught to request six snack items. Requesting involved giving a graphic symbol to the trainer in exchange for the matching snack

item. Following acquisition, we assessed the correspondence between requests and subsequent item selections by requiring the student to select the previously requested snack item from an array containing all six items. The effects of acquisition training were evaluated in a multiple-probe across subjects design. Acquisition was achieved in from 9 to 29 trials per item. Following acquisition, Jason showed a high level of correspondence between requesting and selecting, but Ryan required additional training to achieve correspondence. These data support the use of exchange-based communication systems, but suggest that some students may require explicit correspondence training.

Sigafoos, J., Green, V., Payne, D., Son, S., O'Reilly, M. & Lancioni, G. (2009). A comparison of picture exchange and speech-generating devices: acquisition, preference, and effects on social interaction. *Augmentative and Alternative Communication, 25, 99-109.*
Abstract: Augmentative and alternative communication (AAC) includes picture exchange (PE) and speech-generating devices (SGD), but these two systems have rarely been compared. We therefore conducted three studies comparing PE and SGD for an adolescent boy with a developmental disability. Study 1 compared acquisition of a PE-and SGD-based requesting response and monitored the effects on social interaction. For Study 2, both communication modes were made simultaneously available and the child could choose to use either PE or the SGD. For Study 3, only PE intervention continued, with the distance between the child and trainer systematically increased to prompt social interaction. The results showed equally rapid acquisition of the PE-and SGD-based requesting response, but only the distancing manipulation had any positive effect on social interaction. We conclude that PE and SGD are equally viable modes of communication, but acquisition of an initial PE-or SGD-based requesting response may not be sufficient to promote social interaction.

Simacek, J., Pennington, B., Reichle, J. & Parker-McGowan, Q. (2017). Aided AAC for people with severe to profound and multiple disabilities: A systematic review of interventions and treatment intensity *Advances in Neurodevelopmental Disorders, 2*, 100-115.
https://link.springer.com/article/10.1007/s41252-017-0050-4
Abstract: Given the limited evidence, along with a rapidly evolving state of technology, research is needed to drive effective and efficient communication intervention for people with severe to profound and multiple disabilities. The purpose of the current review was to synthesize and evaluate the state of the aided, augmentative and alternative communication (AAC) intervention literature for this population from 1997 to 2016. Results synthesized findings from 25 studies (n = 59) on the extracted participant characteristics, intervention, and dosage parameters from the studies. Results included an under-reporting of sufficient dosage parameters in addition to implications for future directions in the areas of maintenance, generalization, and discriminated use of skills, and bridging aided low and high-tech AAC interventions.

Simacek, J., Pennington, B., Reichle, J. & Parker-McGowan, Q. (2017). Aided AAC for people with severe to profound and multiple disabilities: A systematic review of interventions and treatment intensity. *Advances in Neurodevelopmental Disorders, 2*, 100-115. **https://doi.org/10.1007/s41252-017-0050-4**
Abstract: Given the limited evidence, along with a rapidly evolving state of technology, research is needed to drive effective and efficient communication intervention for people with severe to profound and multiple disabilities. The purpose of the current review was to synthesize and evaluate the state of the aided, augmentative and alternative communication (AAC) intervention literature for this population from 1997 to 2016. Results synthesized findings from 25 studies (n = 59) on the extracted participant characteristics, intervention, and dosage parameters from the studies. Results included an under-reporting of sufficient dosage parameters in addition to implications for future directions in the areas of maintenance, generalization, and discriminated use of skills, and bridging aided low and high-tech AAC interventions.

Simon, E., Whitehair, P., & Toll, D. (1996). A case study: Follow-up assessment of facilitated communication. *Journal of Autism & Developmental Disorders. 26 (1), 9-18.*
Abstract: A 6-month follow-up of an individual reported to engage in validated facilitated communication (FC) is presented. Three main issues are addressed: the current status of the individual's FC use, the effect of food reinforcers on his communicative ability, and a comparison of FC to the Picture Exchange Communication System (PECS). Results indicated that the individual did not engage in any validated FC, that performance was equivalent on food and nonfood trials, and that PECS was the preferred mode of communication, yielding 100% accuracy in a message-passing, object identification task. Implications of these findings are discussed in the context of an individual's right to communicate by objectively validated methods.

Smith, J., Hand, L., & Dowrick, P. (2014). Video feedforward for rapid learning of a picture-based communication system. *Journal of Autism and Developmental Disorders, 44, 926-936.*
Abstract: This study examined the efficacy of video self modeling (VSM) using feedforward, to teach various goals of a picture exchange communication system (PECS). The participants were two boys with autism and one man with Down syndrome. All three participants were non-verbal with no current functional system of communication; the two children had long histories of PECS failure. A series of replications, with different length baselines, was used to examine whether video self modeling could replace the PECS method of teaching to achieve the same goals. All three participants showed rapid learning of their target behavior when introduced to their self modeling videos, and effects generalized without the need for further intervention. We conclude that VSM, using feedforward, can provide a fast, simple way of teaching the use of a picture-based communication system without the need for prompts or intensive operant conditioning. VSM may provide an accessible, easy-to-use alternative to common methods of teaching augmentative and alternative communication systems.

Stahmer, A. & Ingersoll, B., (2004). Inclusive programming for toddlers with autism spectrum disorders: Outcomes from the Children's Toddler School. *Journal of Positive Behavior Interventions, 6, 67-84.*
Abstract: The passage of the Individuals with Disabilities Education Act of 1990 mandated the provision of interventions for young children with autism spectrum disorders (ASD) under the age of 3 years. Although Strain, McGee, and Kohler (2001) suggested that children with autism benefit from inclusive programming, inclusive early intervention programs are rare. In the current study, the authors used a quasi-experimental design to analyze the outcomes for 20 young children with ASD in an inclusive program for children under age 3. Both outcomes on standardized assessments and functional outcomes were compared at program entry and exit. Significant increases in standard scores were found for the standardized assessments from intake to exit, with 37% of the children functioning in the typical range at exit, compared to 11% at entry. Significant improvements in performance on functional measures were also seen. At intake, 50% of the study participants had no functional communication skills, whereas at exit, 90% used a functional communication system. Social and play behaviors also increased substantially. Use of augmentative communication systems and a combination of research-based programming are discussed. (NOTE: see pages 76-77 in particular re: PECS-"Two of the children on the PECS system began to use spoken language consistently, and they discontinued use of the PECS system. The use of an augmentative system thus did not appear to impair the acquisition of spoken language for these children, as has been previously suggested (McGee et al., 1999).

Stahmer, A., Schreibman, L. & Cunningham, A. (2010). Toward a technology of treatment individualization for young children with autism. *Brain Research, 1380, 229-239.*
Abstract: Although the etiology of autism spectrum disorders (ASD) and early development of the ASD are not yet well understood, recent research in the field of autism has heavily emphasized the importance of early intervention (i.e. treatment before the age of 4 years). Currently, several methods have been demonstrated to be efficacious with some children however no treatment completely ameliorates the symptoms of ASD or works for all children with the disorder. The heterogeneity and developmental nature of the disorder make it unlikely that one specific treatment will be best for all children, or will work for any one child throughout his or her educational career. Thus, this paper examines early research validating different technologies for individualizing treatment. A discussion of current research on pretreatment characteristics associated with differential outcomes in treatment, including child, family, and practitioner variables; and how specific intervention techniques address each of those pre-treatment characteristics is provided. The ultimate goal of this line of research is to enable practitioners to prospectively tailor treatments to specific children and increase the overall rate of positives outcomes for children with autism. Research that furthers understanding of how to match clients with efficacious treatments will decrease the outcome variability that characterizes early intervention research at present, and provide for the most efficient allocation of resources during the critical early intervention time-period. This type of research is in its infancy, but is imperative if we are to determine a priori which treatment

method will be most effective for a specific child. Section involving PECS research: “A recent study evaluated the differential effectiveness of two communication training strategies commonly used to teach early communication skills to nonverbal and minimally verbal young children with ASD (Cunningham et al., 2008). Specifically, this randomized trial addressed the differential effects of a language-based approach (PRT) and a visually based approach (the Picture Exchange Communication System, PECS; Bondy and Frost, 2001) on the communication, social, and cognitive functioning of 34 very young (i.e., 2–4 years-old), minimally verbal children with ASD. Both programs were found to result in substantial spoken language gains for approximately 50% of the children. While early word use was highly predictive of verbal gains in both treatment conditions, it was not predictive of augmentative communication gains. Children with some words (i.e. 1–9 words at intake) were equally likely to develop verbal communication skills in PECS or PRT. Children entering treatment with no words were unlikely to develop spoken language. However, over 80%of the PECS participants developed substantial augmentative communication skills. These preliminary results indicate that word use at intake may be an important and parsimonious child variable to consider when deciding between verbal and augmentative communication programs for very young children with ASD.” p. 225

Stoner, J., Beck, A., Bock, S., Hickey, K., Kosuwan, K., & Thompson, J. (2006). The effectiveness of the Picture Exchange Communication System with nonspeaking adults. *Remedial and Special Education, 27, 154-165.*
Abstract: Picture Exchange Communication System (PECS) training was implemented with 5 nonspeaking adults with mental retardation who were not currently using any type of functional communication system. A modified ABAB, single-subject design was used to assess the effectiveness of PECS in enhancing the functional communication skills of these individuals. Three individuals progressed through 4 PECS training phases relatively quickly and developed functional skills that they were able to display in home and community settings. Two other individuals demonstrated limited progress, and the PECS training did not meaningfully alter their level of communicative competence. Implications for teaching functional communication skills to nonspeaking adults are discussed, and recommendations for future research are provided.

Suchowierska, M., Rupinska, M. & Bondy, A. (2013). Picture Exchange Communication System (PECS): A short “tutorial” for doctors. *Postępy Nauk Medycznych, t. XXVI, nr 1. 95-92.*
Abstract: Summary: One area of persistent difficulties for children with autism is communication, with about 25% of individuals with autism not developing spoken language at all. In light of this information, it is of paramount importance to have means of teaching those individuals how to pass to others information about their needs and wants in a socially appropriate and easily understood manner. Picture Exchange Communication System (PECS) is an empirically validated alternative and augmentative communication method. In the present article we will provide a brief tutorial on PECS that may be of help to health care professionals who in their work come across children with autism. In conclusion, PECS is a method that has been created specifically for individuals who have language development difficulties. It is based

on applied behavior analysis and thus is supported by strong theoretical foundation – mainly Skinner's analysis of verbal behaviour – and empirical research. The system itself has been evaluated in a number of separate studies as well as few meta-analyses. The overall conclusion is that PECS is an effective, evidence-based method that teaches children how to communicate effectively and efficiently. It also reduces rates of problem behavior and for some children is associated with speech development. For interested individuals, more information on PECS can be found at: www.pecs.com.

Sulzer-Azaroff, B., Hoffman, A., Horton, C., Bondy, A., & Frost, L. (2009). The Picture Exchange Communication System (PECS): What Do the Data Say? *Focus on Autism, 24, 89-103.*
Abstract: Originally designed to enable young children with autism lacking functional communication to initiate requests and to describe what they observed, the Picture Exchange Communication System (PECS) has been the subject of an ever-expanding body of research and development. Thirty-four peer-reviewed published reports on PECS are analyzed in this article with documentation of research questions, methodology, and results. Findings suggest that PECS is providing people around the globe who have no or impaired speech with a functional means of communication. Refinements in methodology and additional questions that might be addressed in future research are discussed.

Tincani, M. (2004). Comparing the Picture Exchange Communication System and sign language training for children with autism. *Focus on Autism and Other Developmental Studies, 19, 152-163.*
Abstract: This study compared the effects of Picture Exchange Communication System (PECS) and sign language training on the acquisition of mands (requests for preferred items) of students with autism. The study also examined the differential effects of each modality on students' acquisition of vocal behavior. Participants were two elementary school students with autism enrolled in a suburban public school. Training sessions involved presentations of preferred items, prompting and prompt fading procedures. Probes were conducted to evaluate the generalization of learned mands to classroom teachers. For one participant, sign language training produced a higher percentage of independent mands. PECS training produced a higher percentage of independent mands for the other participant. For both participants, sign language training produced a higher percentage of vocalizations during training. Mands learned with the experimenter generalized to classroom teachers. The results of the study suggest that acquisition of picture exchange and sign language may vary as a function of individual student characteristics, specifically, motor imitation skills prior to intervention. However, further research is needed to determine the optimal procedures for teaching both modalities to students with communication difficulties. (http://www.proedinc.com)

Tincani, M., Crozier, S. & Alazetta, L. (2006). The Picture Exchange Communication System: Effects on manding and speech development for school-aged children with autism. *Education and Training in Developmental Disabilities, 41, 177–184.*
Abstract: We examined the effects of the Picture Exchange Communication System (PECS; Frost

& Bondy, 2002) on the manding (requesting) and speech development of school-aged children with autism. In study 1, two participants, Damian and Bob, were taught PECS within a delayed multiple baseline design. Both participants demonstrated increased levels of manding after implementation of PECS. Only Damian demonstrated any measurable speech during study 1. His speech development occurred primarily during phase IV of PECS. Because of the positive relationship between Phase IV and increased speech for Damian, study 2 was conducted to confirm a functional relationship between phase IV procedures and speech development for an additional participant. Carl received phase IV training procedures in two conditions, administered in an ABAB design. In condition A, no reinforcement was provided for vocalization; in condition B, reinforcement was provided for vocalization after a delay of 3-to 5s. The vocal reinforcement procedures in phase B differentially increased Carl's speech. Results are discussed in terms of research on augmentative and alternative communication and speech development for children with autism.

Tien, K-C. (2008). Effectiveness of the Picture Exchange Communication System as a functional communication intervention for individuals with Autism Spectrum Disorders: A practice-based research synthesis. *Education and Training in Developmental Disabilities, 43, 61-76.*
Abstract: This research synthesis verifies the effectiveness of the Picture Exchange Communication System (PECS) for improving the functional communication skills of individuals with autism spectrum disorders (ASD). The research synthesis was focused on the degree to which variations in PECS training are associated with variations in functional communication outcomes (Dunst, Trivette & Cutspec, 2002). The communication consequences of PECS were examined in 13 studies, which included 125 participants with ASD who had been identified as having limited or no functional communication skills. Claims that PECS is an effective intervention for improving functional communication skills appeared to be supported by the available research evidence.

Tincani, M. & Devis, K. (2010). Quantitative synthesis and component analysis of single-participant studies on the Picture Exchange Communication System. *Remediation and Special Education (Online First), 1-13.*
Abstract: The Picture Exchange Communication System (PECS) has emerged as the augmentative communication intervention of choice for individuals with autism spectrum disorder (ASD), with a supporting body of single-participant studies. This report describes a meta-analysis of 16 single-participant studies on PECS with percentage of non-overlapping data (PND) as the metric of effect size. Results suggest that PECS was moderately effective in establishing mands (PND = 80.1) for 41 participants up to Phase IV of the system. Higher levels of manding were found when PECS was taught to individuals without ASD diagnoses versus those with ASD diagnoses and in single settings versus multiple settings; however, these differences were not statistically significant. For a smaller subset of participants for whom vocalizations were recorded, PECS appeared to facilitate speech, though considerable variability in speech acquisition was evident. While these results support PECS as an evidenced-based communication intervention, they indicate that more research is needed on speech with PECS,

to establish the efficacy of PECS when implemented across settings and communicative partners, and to confirm efficacy of Phases IV, V, and VI.

Travis, J. & Geiger, M. (2010). The effectiveness of the Picture Exchange Communication System (PECS) for children with autism spectrum disorder (ASD): A South African pilot study. *Child Language Teaching and Therapy, 26, 39-59.*
Abstract: This study investigated the effects of introducing the Picture Exchange Communication System (PECS) on the frequency of requesting and commenting and the length of verbal utterances of two children with autism spectrum disorder (ASD) who presented with some spoken language, but limited use of language in communicative exchanges. A mixed research design was used, including a quantitative component — a single-subject multiple-baseline design (MBD) across three behaviours, repeated with two participants — and a qualitative component. Data was collected in the PECS pre-training, training, post-training and follow-up stages, in both structured and unstructured settings. The quantitative data was visually represented and analysed to determine the effectiveness of the PECS. The qualitative component investigated the impact of the PECS on other areas (e.g. communication profile, speech complexity and pragmatic skills), and included parent and educator perspectives. Both participants benefited from the introduction of PECS. The findings indicated highly effective treatment for requesting and mixed results for commenting and length of verbal utterances. There were considerable increases in intentional communicative acts (ICAs) for both participants, with marked increases in requesting (function) and the development of forms of communication (from augmentation of speech with pictures to speech only utterances). Clinical, educational and research implications were raised.

Tincani, M. & Devis, K. (2011). Quantitative synthesis and component analysis of single-participant studies on the Picture Exchange Communication System. *Remedial and Special Education, 32, 458-470.*
Abstract: The Picture Exchange Communication System (PECS) has emerged as the augmentative communication intervention of choice for individuals with autism spectrum disorder (ASD), with a supporting body of single-participant studies. This report describes a meta-analysis of 16 single-participant studies on PECS with percentage of nonoverlapping data (PND) as the metric of effect size. Results suggest that PECS was moderately effective in establishing mands (PND = 80.1) for 41 participants up to Phase IV of the system. Higher levels of manding were found when PECS was taught to individuals without ASD diagnoses versus those with ASD diagnoses and in single settings versus multiple settings; however, these differences were not statistically significant. For a smaller subset of participants for whom vocalizations were recorded, PECS appeared to facilitate speech, though considerable variability in speech acquisition was evident. While these results support PECS as an evidenced-based communication intervention, they indicate that more research is needed on speech with PECS, to establish the efficacy of PECS when implemented across settings and communicative partners, and to confirm efficacy of Phases IV, V, and VI.

Turan, M., Moroz, L. & Paquet-Croteau, N. (2012). Comparing the effectiveness of error-correction strategies in discrete trial training. *Behavior Modification, 36 (2), 218-234.*
Abstract: Error-correction strategies are essential considerations for behavior analysts implementing discrete trial training with children with autism. The research literature, however, is still lacking in the number of studies that compare and evaluate error-correction procedures. The purpose of this study was to compare two error-correction strategies: Independent Probe and Delay across learners with autism in an intensive intervention program. Two studies were conducted. The first study compared the two procedures across receptive tasks for 3 individuals, and differential effects were seen across learners. The second study compared the two procedures across tact trials with two of the same learners and found that individual differences were noted, but in addition, the more effective error-correction strategy was consistent across the two verbal operants (i.e., receptive in Study 1, tacts in Study 2). These combined studies suggest the effectiveness of error-correction strategies may be individualized to the learner but may generalize across operants

Thiemann-Bourque, K. Brady, N., McGuff, S., Stump, K & Naylor, A. (2016). Picture Exchange Communication System and Pals: A Peer-Mediated Augmentative and Alternative Communication Intervention for Minimally Verbal Preschoolers With Autism. *Journal of Speech, Language, and Hearing Research, 59, 1133–1145.*
Abstract: Purpose: This study was conducted to investigate the effectiveness of a social intervention that integrates peer-mediated approaches and the Picture Exchange Communication System (PECS).
Method: Effects were evaluated using a series of A-B designs replicated across 4 children with severe autism and limited verbal skills. Seven peers without disabilities were trained to use PECS and facilitative social skills. Measures of changes included rates of communication behaviors, modes, functions, and engagement.
Results: Outcomes revealed an intervention effect for 1 child with autism, and this effect was replicated across 3 other children. All children improved in peer-directed communication, with greater increases for 2 children during snack time. For each child with autism, the primary communication behavior was to initiate with picture symbols to request; the peer's primary communication was to respond. Two children increased communicative functions to comment and to share, and all 4 children showed improved social engagement. All peers increased their communication with the children with autism.
Conclusions: These findings add to the limited research on the benefits of teaching typically developing peers to be responsive listeners to preschoolers with autism by learning to use PECS. These results invite further investigation of teaching peers other augmentative and alternative communication approaches and how to increase children's communication with peers for different purposes.

Travers, J., Tincani, M, Thompson, J. & Simpson, R. (2016). Picture Exchange Communication System and Facilitated Communication: Contrasting an Evidence-Based Practice with a Discredited Method, in Bryan G. Cook , Melody Tankersley , Timothy J. Landrum (ed.) *Instructional Practices with and without Empirical Validity (Advances in Learning and Behavioral Disabilities, Volume 29) Emerald Group Publishing Limited, pp.85 – 110*
Abstract: Learners with autism require specialized education and supports to ensure acquisition and mastery of various communication skills. This is particularly true for individuals whose disability significantly impacts their language development. Without functional communication, these individuals often engage in severe behavior, have reduced self-determination, and experience diminished quality of life. Accordingly, researchers in special education and related fields have sought ways to improve the communication skills of learners with autism who need specialized language and communication interventions. Although the Picture Exchange Communication System (PECS) is well-established in the empirical literature and has helped countless individuals learn to communicate, the method known as facilitated communication (FC; which also is being called "supported typing" and "rapid prompting method") has become increasingly popular in recent years. Few methods in special education have been as thoroughly discredited as FC and perhaps none are as dangerous. This chapter contrasts the thoroughly debunked FC and its pseudoscientific characteristics with those underpinning PECS. A brief historical account of each method is provided along with key scientific and pseudoscientific features that distinguish science from pseudoscience. Ultimately, our intent is to further clarify how FC is not an augmentative or alternative communication method and why PECS is.

Webb, T. (1999). Look who's talking! *Special Children, April/May.*
Abstract: The author who is a teacher at Avalon Special School, Street, Somerset, introduced PECS to a class of 6, 4/5 year old children, with severe communication difficulties, and of whom 5 have autistic spectrum disorders. The work started mid-September 1998 and within weeks all children who were previously at a pre-verbal level, were verbalising, and now five months on are using spoken language to communicate spontaneously with and without the use of symbols/words.

Webb, T. (2000a) Can children with autism be taught to communicate using PECS? *Good Autism Practice (GAP), 1, 29-43.*
Abstract: This paper reports one of the first studies to be conducted in the UK on the impact of PECS on children with an autism spectrum disorder and severe learning difficulties. Teresa Webb is a teacher at a special school for children with severe and multiple learning difficulties. In September 1998, she introduced PECS to a class of six children aged between 4 and 6 years. All, but one, had an ASD and all had severe communication difficulties. In her opinion, PECS has had a major effect on the children's skills and behaviour and has also influenced how staff work. The parents too report big improvements in their child's communication skills and visitors to the school have been impressed by what they see. Clearly, the conclusions that can be drawn from the study are limited in that there was no comparison group of children who did not

receive PECS or who were engaged in a different intervention and so further research is required. http://www.corelearning.co.uk/gap/index.asp

Webb, T. (2000b). The talking goes on -The Picture Exchange Communication System. *Special Children, June/July 2000.*
Abstract: This article reviews the progress of a group of children 19 months after being introduced to PECS which was reported in Special Children 1999. The group have progressed from using 3-5 word sentences incorporating attributes to spontaneously requesting and commenting both with and without PECS. As speech developed the teacher continued to use PECS as a framework for teaching further communicative functions and a range of curriculum subjects. The familiar framework enabled the assimilation of new concepts and ideas more easily, and they were able to ask and respond to a range of questions. They progressed to more advanced requesting and commenting lessons and used the conjunction 'and' and the indefinite article 'a' within 13 word sentences. There was increasing evidence of generalisation as the taught structures were used spontaneously at home, which underlines the importance of ensuring the same vocabulary is available in all environments. Gradually, the children were observed using commenting spontaneously both with and without PECS, and the skill extended into narrative and description. The author used PECS right across the day, which enabled language to be integrated with the social and environmental context and enabled the mapping of language onto experiences. The development of functional communication impacted on reducing contextually inappropriate behaviours. In fact it also raised the question of whose behaviour changed the most, the children's or the staff? Staff found that by using PECS they could eliminate prompts, allow time to observe, facilitate children to respond and self-correct, and as a result peer interaction and independence was able to develop.

Webb, T., Baker, S. & Bondy, A. (2005). Picture Exchange Communication System. In L. Wankoff (Ed.) *Innovative Methods in Language Intervention. (pp. 111-139). Austin, TX: Pro-Ed Inc.*
Abstract: Book chapter, based on work by Teresa Webb and Sue Baker in a class in the UK.

Wendt, O., Hsu, N., Simon, K., Dienhart, A. & Cain, L. (2019). Effects of an iPad-based speech-generating device infused into instruction with the Picture Exchange Communication System for adolescents and adults with severe autism spectrum disorder. *Behavior Modification,* 43 (6), 898-932.
Abstract: This study used a multiple baseline, single-subject research design to investigate the efficacy of an iPad®-based speech-generating device (SGD). The iPad was equipped with the SPEAKall!® application to function as a SGD. SGDs are a form of aided augmentative and alternative communication (AAC) allowing a user to communicate using digitized and/or synthesized speech. Instruction followed a modified version of the intervention phases from the Picture Exchange Communication System (PECS). This modified PECS protocol was implemented with two adolescents and one young adult between the ages of 14 and 23. All three participants were diagnosed with severe autism spectrum disorder and little to no

functional speech. Dependent measures included the ability to request for edible and tangible items as the primary measure, and the ability to engage in natural speech production as an ancillary measure to determine simultaneous, additive effects on speech acquisition. Results indicated increases in requesting behaviors for all three participants across intervention and maintenance phases. Once participants mastered requesting of edible items, they were able to generalize the skill to tangible items. However, mixed results were found when targeting natural speech production. Based on the current findings, the infusion of an iPad-based SGD into PECS instruction may be effective in increasing initial requesting skills; however, a facilitative effect on increasing speech acquisition cannot necessarily be expected for every participant.

Whitby, P., Kucharczyk, S. & Lorah, E. (2019). Teaching object exchange for communication to a young girl with autism spectrum disorder and visual impairment. *Journal of Visual Impairment and Blindness, 113*, 372-380.
Abstract: AAC systems such as the Picture Exchange Communication System (Frost & Bondy, 2002) are found in evidence-based literature for learners with ASD. Adapting such systems for learners with comorbid conditions extends access of these practices to children and youths who could benefit and extends the research literature. Overall, object exchange was an effective intervention for Laura and her family.

Wood, A. L. Luiselli, J. K. Harchik, A. E. (2007). Training Instructional Skills with Paraprofessional Service Providers at a Community-Based Habilitation Setting. *Behavior Modification, 31, 847-855.*
Abstract: The present study evaluates a training program with paraprofessional service providers at a community-based habilitation setting. Four staff were taught to implement alternative and augmentative communication instruction with an adult who had autism and mental retardation through a combination of instruction, demonstration, behavior rehearsal, and performance feedback. Training was conducted under natural conditions at the adult's group home residence. Three of the four staff were able to maintain near-100% instructional accuracy following initial training. The results add to the limited research literature concerning community-based training of direct-care personnel.

Yoder, P. & Lieberman, R. (2010). Brief Report: Randomized Test of the Efficacy of Picture Exchange Communication System on Highly Generalized Picture Exchanges in Children with ASD. *Journal of Autism and Developmental Disorder, 40, 629-632.*
Abstract: A randomized control trial comparing two social-communication interventions in young children with autism examined far-transfer of the use of picture exchange to communicate. Thirty-six children were randomly assigned to one of two treatment conditions, one of which was the Picture Exchange Communication System (PECS). All children had access to picture symbols during assessments. Post-treatment measurement of the number of picture exchanges in a far-transfer, assessment context favored the PECS intervention. These findings were interpreted as support for the hypothesis that the PECS curriculum can successfully teach

a generalized means of showing coordinated attention to object and person without requiring eye contact to children with ASD.

Yoder, P. & Stone, W. (2006). Randomized comparison of the effect of two prelinguistic communication interventions on the acquisition of spoken communication in preschoolers With ASD. *Journal of Speech, Language, and Hearing Research, 49, 698-711.*
Abstract: This randomized group experiment compared the efficacy of 2 communication interventions (Responsive Education and Prelinguistic Milieu Teaching [RPMT] and the Picture Exchange Communication System [PECS]) on spoken communication in 36 preschoolers with autism spectrum disorders (ASD). Each treatment was delivered to children for a maximum total of 24 hr over a 6-month period. Spoken communication was assessed in a rigorous test of generalization at pretreatment, post-treatment, and 6-month follow-up periods. PECS was more successful than RPMT in increasing the number of nonimitative spoken communication acts and the number of different nonimitative words used at the post-treatment period. Considering growth over all 3 measurement periods, an exploratory analysis showed that growth rate of the number of different nonimitative words was faster in the PECS group than in the RPMT group for children who began treatment with relatively high object exploration. In contrast, analogous slopes were steeper in the RPMT group than in the PECS group for children who began treatment with relatively low object exploration.

Yoder, P. & Stone, W. (2006). Randomized comparison of two communication interventions for preschoolers with autism spectrum disorders. *Journal of Consulting and Clinical Psychology, 74, 426-35.*
Abstract: This randomized group experiment compared the efficacy of 2 communication interventions (Responsive Education and Prelinguistic Milieu Teaching [RPMT] and the Picture Exchange Communication System [PECS]) in 36 preschoolers with autism spectrum disorders. Each treatment was delivered 3 times per week, in 20-min sessions, for 6 months. The results revealed that the RPMT facilitated the frequency of generalized turn taking and generalized initiating joint attention more than did the PECS. The latter effect occurred only for children who began treatment with at least some initiating joint attention. In contrast, the PECS facilitated generalized requests more than the RPMT in children with very little initiating joint attention prior to treatment. These effect sizes were large.

Yokoyama, K., Naoi, N., & Yamamoto, J. (2006). Teaching verbal behavior using the Picture Exchange Communication System (PECS) with children with autistic spectrum disorder. *Japanese Journal of Special Education, 43, 485-503.*
Abstract: The Picture Exchange Communication System (PECS) is widely used with non-verbal children with autistic disorders as an Augmentative and Alternative Communication (AAC). Most of the participants in prior research on that method, although referred to as non-verbal, had initial vocal repertoires of at least a few words. The purpose of the present study was to examine whether 3 elementary-school-age children with autistic disorders whose vocal repertoires were severely limited, such as only a few phonemes, could acquire elementary

communication skills using PECS. The present study incorporated task analysis, in which a sequence of picture-exchanging behaviors was divided into 4 components. The results demonstrated that all 3 children acquired the basic components of PECS within a short period. Data from the task analysis revealed that, with increased use of PECS, their prior mode of communication (grabbing, reaching, or crying) was gradually replaced, thereby indicating the reinforcing value embedded in PECS. In addition, the present data suggest that PECS training produced collateral behavioral changes, such as an emergence of intelligible vocalization, even in students who had previously had severely limited vocal repertoires.

Ziomek, M. & Rehfeldt, R.A. (2008) Investigating the acquisition, generalization, and emergence of untrained verbal operants for mands acquired using the Picture Exchange Communication System in adults with severe developmental disabilities. *The Analysis of Verbal Behavior, 24, 15-30.*

Abstract: This study compared the total amount of training time and total number of trial blocks for individuals with severe developmental disabilities to acquire mands under control of unconditioned establishing operations and mands under control of transitive conditioned establishing operations for manual sign and for the Picture Exchange Communication System (PECS). Also examined was the generalization of mands across settings and communicative partners, as well as the emergence of untrained tacts and intraverbals for mands acquired using PECS. Mands for preferred items and for items needed to complete a chained task were acquired more rapidly and in fewer training blocks for PECS than for manual sign. Moreover, mands established using PECS generalized across settings and communicative partners. Finally, untrained tacts and intraverbals using PECS were shown to emerge for some of the participants following PECS training. These results suggest that PECS may be a viable alternative communication system for adults with severe developmental disabilities who have little or no history of systematic instruction and limited imitative repertoires.