Critical Review:
PECS and Speech Outcomes for Minimally Verbal Children with ASD

Christina Fraser
M.Cl.Sc (SLP) Candidate
University of Western Ontario: School of Communication Sciences and Disorders

This critical review examines the evidence regarding the Picture Exchange Communication System (PECS) intervention delivered by speech-language pathologists (S-LPs) to minimally verbal children with Autism Spectrum Disorder (ASD) and its effects on spoken language. A total of six studies were described in this review (2 randomized controlled studies, 2 single-subject designs, 1 non-randomized clinical trial and 1 meta-analysis). *Overall, the results are somewhat suggestive of increases in speech productions following PECS intervention for minimally verbal children with ASD.*

Introduction

Autism Spectrum Disorder (ASD) is a developmental disorder presenting with lifelong communication and behavioural implications (Autism Speaks, n.d.). The National Autism Spectrum Disorder Surveillance System revealed that 1 in 66 children in Canada are diagnosed with ASD and about 1/3 of diagnosed individuals remain non-verbal (NASS, 2018). Many individuals with ASD often rely on augmentative and alternative communication strategies (AAC) to support functional communication. The heterogeneous nature of ASD combined with the wide variety of available AAC strategies can make it challenging to determine the most suitable strategy for individuals (Yoder and Stone, 2006).

Picture exchange communication system (PECS) is a commonly implemented intervention strategy for adults and children with ASD who require support with acquiring functional communication. The program was originally developed and manualized by Bondy and Frost (1994) as a strategy to initiate a communicative intent (request) without the need for speech or eye contact. The PECS protocol includes 6 phases (1-3 includes: acquiring mastery of picture identification and selection, and 4-6 includes: building sentences with pictures to make requests, comments and respond to questions). Progression to the next phase occurs only with mastery of the previous phase, independent of time. When recommending PECS as an intervention strategy, parents often express concern regarding implementing a system where spoken language is not a required element (Schreibman & Stahmer, 2014) for fear that their child will rely on the pictures instead of using speech (Flippin et al., 2010). In practice, professionals refer to evidence that the use of this picture exchange modality does not hinder or delay speech development (Bondy & Frost, 1994; Ganz et al., 2014) but comment on the limited research that explores speech acquisition as a possible outcome of PECS. Therefore, this critical review examines the evidence in both single case studies and group studies that address the question "Does PECS facilitate speech outcomes of minimally verbal children with ASD?". Research that specifically examines speech outcomes related to PECS is limited to a few single-case studies. However, intervention studies including PECS are an additional possible source of evidence regarding speech outcomes for PECS.

Objective

The objective of this critical analysis was to evaluate the efficacy of describing speech as a collateral outcome of PECS intervention in minimally verbal children with ASD.

Methods

Search Strategy

Computerized databases were searched including Taylor and Francis Medical Library, Sage CRKN Collection, Scholars Portal Journals: Sage, Scholars Portal Journals: Springer and Scholars Portal Canadian Public Documents Collection. Additional articles were extracted from references lists of included papers. Selected papers included search terms [Autism OR ASD], AND [Picture Exchange Communication OR PECS], AND [speech, speech outcome, spoken communication].

Selection Criteria

Studies were required to measure speech outcomes of PECS and include participants between 18 months-10 years old who were diagnosed with ASD. Moreover, participants were to be formally assessed as minimally verbal or non-verbal prior to the study's intervention stage.

Data Collection

The search yielded 6 papers in total. Of these, two papers were randomized controlled studies (Yoder & Stone, 2006; Schreibman & Stahmer, 2014), two were single-subject design (Boesch et al., 2013; Carson, Moosa, Theurer, & Cardy, 2013) one was a non-randomized clinical trial (Carr & Felce, 2007) and one was a meta-analysis (Ganz et al., 2014).

Results

Randomized Controlled Studies

Yoder and Stone (2006) completed a randomized group experiment involving 36 children (18-60 months) with ASD to determine the relative efficacy of Responsive Pre-linguistic Milieu Teaching (RPMT: n=19) versus PECS (n=17) for promoting spoken language. The children were selected from an original sample of 120 based on well-specified inclusion criteria and were randomly assigned to either RPMT or PECS using a computer program. Treatment fidelity was analyzed. No baseline differences were observed between groups. Prior to the experiment, children were assessed on speech skills, among others, using commonly used assessment measures. Participants completed intervention in 20-minute sessions, three times per week over 6 months with up to 15 hours of parent training. Treatment descriptions were described in detail and according to referenced treatment manuals. Outcome measures for spoken language were frequency of non-imitative speech acts and number of different nonimitative-words. Data was collected at three time points (pre-treatment, post-treatment and 6-month follow-up) from video-taped records of free play sessions. Free-play sessions with a variety of objects outside treatment objects supports that this research can comment on generalization effects.

Qualitative results revealed that participants experienced statistically significant increases in frequency of non-imitative spoken communication and number of different nonimitative words. Moreover, a moderate treatment effect size favoured PECS for both measures of spoken communication post treatment. A main effect for treatment was found at the 6-month follow-up only when the researchers considered the initial object exploration of the children. If children have a sufficient interest in objects, PECS was more powerful at affecting maintenance of spoken communication 6 months post-treatment. *Overall, this study provides suggestive evidence that PECS facilitates speech outcomes in children with ASD but that it may depend on preintervention child factors.*

Schreibman and Stahmer (2014) completed a randomized clinical trial examining 39 participants with ASD (20-45 months old) randomly assigned to Pivotal Response Treatment (PRT) or PECS (n=19). Participants were identified as nonverbal or minimally verbal using common standardized methods. A stratified procedure was used for randomization such that pairs matched on word use, age, and cognitive functioning were randomly assigned to either PRT or PECS. The child's primary caregiver participated in training for 4h/week for 15 weeks in the laboratory, and an additional 2h/ week for 8 weeks in the home for their respective treatment condition. Parent training was well described. Participants completed 181-263 hours of intervention across 23 weeks based on procedures outlined by the respective treatment manuals. The treatment protocol was not well described by the paper itself. Therapy sessions were video recorded and coded for fidelity by a blind coder. Outcome measures relevant to this review included spoken language and spoken vocabulary and were assessed pretreatment, post treatment and at a 3-month follow-up using standardized measures. Staff assessed the children they were not training.

Appropriate statistical analysis showed a significant increase in both spoken outcome measures at post assessment, especially for raw number of words produced (pre-treatment: M=5.3; follow-up: M=129.8). *Overall, this study provides suggestive evidence that PECS facilitates speech outcomes in children with ASD.*

Single-Subject Studies

Boesch, Wendt, Subramanian, and Ning (2013) completed a single-subject multiple baseline study with an embedded alternating treatment design examining 3 participants (6, 7, and 10 years old) with ASD to compare social-communicative behaviour and speech production outcomes of (PECS) versus a Speech-Generating Device (SGD). This critical review is interested in the results examining speech production as an outcome of PECS intervention. Speech skills of participants were assessed using standardized measures and to ensure study candidacy based on well-specified inclusion criteria. All participants were assessed as non-verbal. Participants completed interventions 2-4 times per week (15 minutes each) for 5 months as part of six phases (Baseline, Phase 1, Phase 2, Phase 3, Follow-up and Maintenance). AAC devices (PECS communication book and the Logan Proxtalker) contained identical graphic picture cards. Both treatment conditions were presented in random order in equal amounts from baseline to Phase 3. Baseline data was sufficiently collected for a minimum of three sessions for all participants. The length of each phase and number of days of treatment exposure varied due to timing of achieving mastery criterion. After phase 3, participants continued with the treatment for which they achieved

the greatest mastery for three follow-up sessions. Long-term results of the treatment were gathered 2 months after follow-up within three maintenance sessions. The research measured the total number of speech utterances through observation and event recording every session by trained observers. Speech utterance is clearly described and operationally defined. Interobserver agreement was high for speech data (100%).

Appropriate visual analysis and effect size calculations revealed that increases in speech were not experienced by any of participants. 1/3 of the children remained to produce few speech approximations while 2/3 of the children remained to produce no-intentional vocalizations. Participant pre-treatment speech skills remained stable. *This study found suggestive evidence that PECS has no impact on speech outcomes in children with ASD.*

Carson, Moosa, Theurer, and Cardy (2012) conducted a single-subject study, including 3 male participants (3 years 5 months; 3 years 5months; 2 years 4 months) to measure changes in speech output in young children with ASD following the implementation of PECS. The participants met specifically outlined inclusion criteria. Sessions occurred once per week for 30-40 minutes over 5 months (18 sessions) including baseline sessions (number unspecified). Intervention procedures followed the PECS protocol according to the manual and was described in detail. Pre-intervention and post-intervention procedures were explained in detail. The researchers assessed the participants speech, language, and behaviour skills pre and post intervention using commonly standardized assessments. The researchers also collected 3 language samples preintervention and 3 language samples post intervention to establish a representative sample of speech skills. Speech production data was collected monthly from video recordings as well as postintervention language samples to be compared to preintervention characteristics such as symbolic representation skills, language skills, imitation skills and adaptative functioning. Speech productions included operationally defined sounds and words. Interobserver agreement was calculated and solidified appropriately.

Descriptive results revealed Participants 1 and 2 experienced slight increases in sound requests from baseline. The third participant produced the word "open" to request on four occasions. Participant three demonstrated higher imitation scores, suggesting that imitation skills may increase the likelihood of increased speech outcomes following PECS. *Overall, this study provides somewhat suggestive evidence that PECS facilitates speech outcomes in children with ASD, specifically for initiating requests.*

Non-randomized Clinical Trial

Carr and Felce (2007) completed a non-randomized clinical trial examining 24 participants (12 per group), 3-7 years old with ASD, to determine the speech outcomes of training PECS to phase 3. The study included within and between groups measures with a nonintervention control group to account for maturation effects of the treatment condition. Participants were sorted into groups subject to disclosed individual factors that controlled against selection bias. All participants met specific inclusion criteria outlined by the researchers. Prior to the treatment phases, language skills and behaviour were assessed using commonly used standardized measures. Age, language skills and behaviour characteristics were determined comparable between groups. The intervention group completed 15 hours of PECS instruction provided by the researchers up to Phase 3 over a period of 4-5 weeks in their school environment. Teachers verified that the control group received no special intervention beyond their classroom curriculum. An observation instrument was designed to record the communicative interactions (speech, manual, sign, and non-linguistic) between children and educators based on two dimensions (1. frequency and type of spontaneous child initiations: 2. frequency and type of child reply to adult initiations). This critical review is focused on data regarding the combined number of initiations and responses of the speech type. Baseline data was collected for the treatment group during a 2-hour observation prior to week 1 of intervention. Two observation sessions (2 hours each) were conducted during the treatment phase for both groups (week 1 and week 5).

Descriptive results revealed that none of the children in the control group produced spoken words by week 5 if they were not already producing speech by week 1. Only children in the PECS group who had some spoken production prior to treatment produced appreciable post-treatment gains in speech production by the final observation. *Overall, this study provides highly suggestive evidence that PECS facilitates speech outcomes in children with ASD, who are already producing speech.*

Meta-analysis

Ganz, Mason, Goodwyn, Boles, Heath, and Davis (2014) conducted a meta-analysis of 35 studies assessing the interaction of participant characteristics and type of AAC with individuals with ASD. Types of AAC included PECS, speech-generating devices (SGD) and other picture-based AAC. Some participants with ASD were diagnosed with comorbid intellectual/developmental disorders (IDD). This critical review is interested in data extracted from 9 studies

investigating speech outcomes. Specifically, the 3/9 studies that include individuals (n=9) with an isolated diagnosis of ASD receiving PECS training. The research explored the differential impacts of PECS on speech outcomes related to participant speech abilities at onset of intervention. Appropriate search terms and databases were explored. The seven selection criteria for all included and excluded studies were adequately outlined and described. Accepted articles were coded and organized by elements such as quality of the research, comorbid diagnosis, type of AAC implemented, speech at the outset of the study and study results. Improvement Rate Difference (IRD), an effect size measure, was used to calculate the magnitude of change between baseline and intervention phases. The process for calculating IRD is described in detail. The effect sizes were plotted on a forest plot.

The research revealed that high speech levels prior to PECS intervention were positively related to speech outcomes (IRD= .55 moderate effect size). Many participants who began with little to no functional speech experienced at least small increases in speech (IRD= .43, small effect size). However, the results did not distinguish between the speech outcome effects of PECS for children with isolated ASD versus children with comorbid IDD. The authors disclosed that due to the limited number of studies that measured speech outcomes, results should be viewed with some caution. *Overall, this study provides somewhat suggestive evidence that that PECS facilitates speech outcomes in children with ASD.*

Discussion

This critical analysis examined evidence related to speech outcomes following the implementation of PECS protocol as an intervention strategy for children with ASD. *Overall, there was suggestive evidence that PECS facilitates speech outcomes in children with ASD* across six studies. The findings were reasonably consistent with only one study showing no evidence for an increase in speech outcomes for any of their participants (Boesch, Wendt, Subramanian, and Ning, 2013).

In considering participant characteristics, 4/6 studies speculated that speech outcomes may heavily depend on participant speech skills prior to intervention such that high speech output from the start improves the likelihood of experiencing possible increases in speech as an ancillary outcome of PECS (Carr and Felce, 2007; Carson et al., 2012; Ganz et al., 2014; Yoder and Stone, 2006). In the studies where PECS did not contribute to increases in speech production, participant speech outcomes remained stable (Boesch et al., 2013). However, the finding that children in the Boesch et al., (2013) study produced only non-intentional vocalizations throughout the study, further supports that high speech output prior to treatment may be positively related to increases in speech output post-treatment. Furthermore, the participants in the Boesch et al. (2013) study were older than participants from other studies (6-10 years old).

Factors such as study design and study procedure are weaknesses in the examined research that reduce the strength of results. Only Carr and Felce (2007) controlled for maturation effects such that increases in speech identified by the other studies could be more easily explained by natural speech development. Moreover, some studies include data only up to phase 3 of the PECS protocol (Carr and Felce, 2007; Boesch et al. 2013) such that conclusions for these studies should not apply to PECS in general.

Future Research

There is limited research including the speech outcomes of PECS. As a popular concern of professional and parent in considering PECS for a nonverbal or minimally verbal child with ASD, the impacts of PECS on speech development are important to explore in research. Future research should strive for well controlled designs, with larger sample sizes, that include data on all 6 phases of the protocol and measure generalization and maintenance of treatment. However, given the difficulty of recruiting large groups and the heterogeneity of the participant characteristics, well designed single subject studies may be a helpful alternative.

Clinical Implications

Overall, current research provides somewhat suggestive evidence that PECS may lead to collateral increases in speech for minimally verbal children with ASD. When increases are not experienced, speech skills remain stable. Given that few of the included studies were confidently able to determine that increases in speech outcomes can be generalized or maintained beyond the treatment period, SLPs should be cautious in describing speech output as a potential outcome of PECS. Monitoring of individual outcomes will be necessary in light of the current evidence that speech outcomes may heavily depend on participant characteristics prior to PECS intervention.

It is important to note that the purpose of PECS is to provide individuals with a means to communicate through picture exchange. Therefore, PECS is not an intervention for speech development.

References

Autism Speaks (n.d.). What is autism? Retrieved from https://www.autismspeaks.ca/about/about-autism/

Boesch, M., Wendt, O., Subramanian, A., & H. Ning (2013). Comparative efficacy of the picture exchange communication versus a speech generating device: Effects on social-communicative skills and speech development. *International Society for Augmentative and Alternative Communication, 29*(3), 197-209.

Bondy, A. & Frost, L. (1994). The Picture Exchange Communication System, *Focus on Autistic Behaviour, 9*(3).

Carr, D. & Felce, J. (2007). Brief report: Increase in production of spoken words in some children with autism after PECS teaching to phase III. *Journal of Autism and Developmental Disorders, 37*, 780-787.

Carson, L., Moosa, T., Theurer, 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*(3), 182-184.

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, 19*(6), 516–535.

National Autism Spectrum Disorder Surveillance System. (2018). *Autism spectrum disorder among children and youth in Canada 2018: A report of the National Autism Spectrum Disorder Surveillance System*. Ottawa, ON: Canada.

Schreibman, L. & Stahmer, A. C. (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.

Yoder, P. & Stone, W. (2006). A randomized comparison of the effect of two prelinguistic interventions on the acquisition of spoken communication in preschoolers with ASD. *Journal of Speech Language and Hearing Research, 49*, 698-711.