Critical Review:
Effectiveness and generalization of literacy intervention in people who use alternative augmentative communication

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Literacy competencies allow people with complex communication needs (CCN) who use alternative augmentative communication (AAC) to have more independence in their communication as it enables them to produce novel messages. However, this population is at risk for not developing literacy due to a variety of individual and systemic barriers. This critical review examines the evidence regarding literacy interventions and their effectiveness for people with CCN who use AAC. Single-subject and case-series are included. Recommendations for future research and critical practice are provided.

Introduction

Alternative Augmentative Communication (AAC) is often used by people with complex communication needs (CCN) to aid communication due to impairments in language, speech, cognition and/ or motor skills. The AAC device or strategy often focuses on allowing the person to express their needs, and may not address other communicative purposes such as social closeness or academic skills such as literacy.

Literacy is an influential "tool for achieving cultural and social power" that can enhance cognitive development, create advances in learning, and can provide greater access to employment opportunities (Fallon & Katz, 2008; Light, McNaughton, Weyer, Karg, 2008). Despite its impact, the literature suggests that people who use AAC are at risk for not developing literacy. According to Sturm, Spadorcia, Cunningham, Staples, Erickson, Toder, and Koppenhaver (2009), few students who use AAC "achieve literacy skills beyond the second-grade level".

People with CCN who use AAC can be limited in their literacy experience due to individual, environmental, and systemic barriers such as absenteeism due to health problems, competence/ knowledge of the professionals, exposure to/ opportunities for literacy, expectations of/ for a person with CCN, access to resources/ funding, and a lack of effective evidence-based instruction (Heller, Fredrick, Tumlin, Brineman, 2002; Johnston, Davenport, Kanarowski, Rhodehouse, McDonnell, 2009; Light et al. 2008). The current literature suggests that intervention for people who require AAC should be explicit, intensive, individualized, and scaffolded (Soto & Dukhovny, 2008; Machalicek, Sanford, Lang, Rispoli, Molfenter, Mbeseha, 2009). However, there is a need for the development and evaluation of literacy focused intervention designed to provide individuals who use AAC with the required support needed to improve literacy skills (Light et al. 2008).

Professionals involved in supporting literacy development for this population need to take responsibility for the barriers they may be creating such as lack of knowledge or lack of evidence-based instruction. In reviewing the existing literature, we can examine successful methods and determine where further research is needed. It is paramount that clinicians document and share data on intervention efficacy in this area to address the paucity of available evidence based interventions.

Objectives

The primary objective of this paper was to critically evaluate existing literature regarding the effectiveness and generalization of literacy intervention in people with CCN who use AAC.

Methods

Search Strategy

A variety of computerized databases, including CINAHL, PubMed, and Psych Info were searched using the following terms:

> (augmentative alternative communication) OR (AAC) AND (literacy) OR (phonological awareness)

The search was limited to articles written in English between 2000 and 2017.

Selection Criteria

Studies selected for inclusion in this review paper were required to include subjects who used AAC in their daily lives. The participants had to undergo some form of direct literacy or pre-literacy intervention.

Data Collection

The results of the literature search yielded seven studies that met the selection criteria: one case study, one single-subject design, and five case-series studies.

Results

Single-subject and case-series designs

A single-sujbect design is a "scientific methodology used to define basic principles of behaviour and establish evidence-based practices" by measuring change across an individual (Horner, Carr, Halle, Mcgee, Odom, Wolery, 2005). Case-series designs are similar however they measure a group of individuals against themselves. These designs are appropriate for heterogeneous populations such as people with CCN who all have very individual characteristics and needs. It is appropriate for these designs to implement visual analysis of data across baseline, intervention, and maintenance in order to determine change in the dependent variable. The limitation of these designs however, are the generalizability of results and potential participant selection bias.

A case study was conducted by Light et al. (2008) investigating the effectiveness of an individualized literacy intervention on an 8-year-old girl who used AAC. Though the exact intervention was not outlined, the authors targeted pre-literacy skills, decoding, shared reading, and writing/keyboard skills over a 16-month period ensuring mastery at each level. Baseline was assessed to determine a starting point however these results were not displayed.

The treatment effect data was displayed in a table as a list of skills mastered in 8 month phases which is appropriate for this design. There was no explanation provided on criterion for mastery or how each target was measured. The results would have been more significant if the authors had been able to implement a higher level of design such as single-subject. Over 16 months, the participant was able to improve from no literacy skills to reading simple sentences with at least 90% accuracy, and typing short sentences with scaffolding.

Despite limitations in data collection and description of intervention programming, this study provides suggestive evidence that highly individualized literacy intervention can lead to acquisition of successful reading for a child who uses AAC.

Soto and Dukhovny (2008) implemented a multiple baseline single-subject design on a 7-year-old girl who used AAC in order to examine the effect of shared book reading on the acquisition of expressive vocabulary. Inclusion criteria were appropriate, and treatment schedule and intervention description were clearly outlined. Probe measures of the number of different words (NDW), number of total words (NTW), number of multiword utterances, and number of story constituents were used in baseline, intervention and maintenance phases which are typical measures of functional expressive vocabulary.

Appropriate analysis of the data was completed. The researchers used visual interpretations of graphs to analyze the data from each session. The results showed increases in NDW, NTW and multiword utterances which were maintained 6-weeks post intervention. Some gains with story constituents were also observed, however, they were not maintained. The authors provided compelling evidence of interrater, ecological, and social validity to support their results.

As the shared reading program was multifactorial, there is a limitation of inferring the most influential factor that impacted expressive language growth. Despite this limitation, this study provides highly suggestive evidence of the relationship between shared book reading and increased expressive language.

Fallon, Light, McNaughton, Drager, and Hammer, (2004) conducted a multiple baseline case series with five children who used AAC to investigate whether direct instruction could improve decoding skills using treated and untreated words. Appropriate inclusion criteria and stimuli were implemented. Intervention was well described, developmentally appropriate, and organized. Multiple probe measures of number of target words read correctly were used through baseline and intervention. Number of untreated words read correctly were used in generalization and maintenance phases.

A visual analysis was appropriately used to summarize the data including error analysis for all incorrect probe responses as well as percentage of non-overlapping data which strengthened treatment effect results. The study reported acceptable procedural and interrater reliability. All five participants reached criterion (80% accuracy) and maintained skills two months post intervention for decoding of targeted words. Three participants showed generalization of decoding of untreated words.

There is suggestive evidence provided by this study despite its limitations in design to support the effectiveness of direct instruction in the improvement of decoding skills of children who use AAC. The authors implemented error analysis in order to more accurately determine if the child was sight reading or decoding the word, and probed decoding within a book

reading context which increased the validity of their results.

Heller et al. (2002) used a case-series multiple baseline design with three students with severe speech and physical impairments (SSPI) to examine the effectiveness of the Nonverbal Reading Approach (NRA) in decoding treated and untreated words. Appropriate inclusion criteria were employed, and all students had specific neurodevelopmental conditions. A probe measure of treated and untreated word reading was completed during baseline, intervention 1, generalization, and intervention 2 phases. Interventions were well described including target word choice and criterion to implement the second intervention phase, however, the treatment schedule was unclear.

The researchers used appropriate visual interpretations of graphs for analysis and percentage of correct responses to verify decoding skill growth. Statistical evidence was not reported however this is acceptable for this type of study. Results revealed that all participants reached 80% accuracy on reading treated words. One participant showed generalization to untreated words.

Overall, this study provides suggestive evidence to support the effectiveness of direct instruction of decoding skills through NRA as a means of supporting literacy development for people with SSPI who use AAC.

A multiple baseline case series of two children who used AAC was conducted by Johnston et al. (2009) investigating the effectiveness of sound/letter correspondence and spelling intervention on treated and untreated words. Appropriate inclusion criteria were implemented and the description of treatment was clear and organized. The authors used probe measures of number of correct letter identifications (lower and upper case), and number of correctly spelled words across baseline, intervention, and maintenance phases.

The researchers appropriately used visual interpretations of graphs as well as error analysis to summarize data. The results showed both participants improved and maintained letter identification as well as spelling skills of treated words. One child generalized across case size. Some generalizations were made by both participants on untreated words, and error analysis revealed that they were phonological errors rather than random errors. The authors also conducted a social validity survey to support the effectiveness of their program and gathered strong positive feedback from school staff.

Overall, this study provides highly suggestive evidence to support the effectiveness of sound/letter correspondence and spelling intervention carried out within the classroom.

Hanser and Erickson (2007) conducted a multiple baseline case series study of three children who used AAC in order to examine the effect of integrating word identification and communication intervention on word identification skills and their generalization. Appropriate inclusion criteria were implemented.

The researchers utilized the *Literacy Through Unity: Word Study* software to implement 75 lessons supported by a facilitator. They collected pre- and post-intervention measures of word identification, icon sequencing, expressive communication, word generation and developmental spelling. The Language Activity Monitor (LAM) recorded number of icon sequences selected, and number of letters selected outside of actual instructional time across baseline, intervention and maintenance as probe measures to capture generalization of skills.

The authors appropriately used descriptive statistics and visual analysis to represent the data. However, overall the results are poorly described and the authors often average the participant's scores to indicate how effective the program was, which is inappropriate for a case series design. Phases were examined overall rather than iteratively due to day-to-day variability. The results were interpreted to suggest generalization of icon sequencing for two participants, and increase in spelling for all three.

This study provides slightly suggestive evidence to support the effectiveness of integrating word identification and communication intervention on improving and generalizing word identification skills.

A case-series of two multiple baseline experiments was conducted by Truxler and O'Keefe (2007) over seven months examining the effects of phonological awareness instruction on beginning word recognition and spelling for four children who used AAC. Qualitative inclusion criteria were appropriate however, there were potential floor effects on the standardized language tests which may have led to inaccurate information about participants' skills. The description of intervention was disorderly, and followed a baseline, intervention, maintenance schedule with each child having variable additional unspecified training throughout. Probe measures of percent correct letter/sound identification for treated and untreated positions as well as percentage correct word recognition for treated and untreated words were used. The authors

moved the participants to phase two of the experiment whether or not the child had reached criterion of 80%.

Appropriate analysis of the data and visual interpretations of graphs were completed. Two participants showed increases in spelling and one participant showed gains in word recognition and spelling, however no participants showed maintenance or generalization of skills.

Ultimately, the researchers used inappropriate inclusion criteria for language that lead to assumptions about skill level. They found that the participants needed more critical level phoneme awareness instruction in more increments than what was provided. Therefore, this study provides equivocal evidence to support the authors' phoneme awareness approach in teaching word recognition skills to children who use AAC.

Discussion

The present study provided a critical review of seven studies examining the effectiveness of literacy intervention in people with CCN who use AAC. Overall, five of the studies provided suggestive to highly suggestive evidence of positive effects of literacy intervention for AAC users (Heller et al., 2002; Fallon et al., 2005; Light et al. 2008; Johnston et al., 2009; Soto & Dukhovny, 2008), while two of the studies provided slightly suggestive and equivocal evidence (Hanser & Erickson, 2007; Truxler & O'Keefe, 2007). The five supportive studies were distinguished by their use of appropriate outcome measures and stronger research designs.

One important factor addressed in those studies providing clear evidence of a positive intervention effect was the attention to skill mastery (Heller et al., 2002; Fallon et al., 2005; Light et al. 2008; Johnston et al., 2009; Soto & Dukhovny, 2008). A skill can be broken down into a hierarchy from easy to difficult and typically, learners must progress through the hierarchy. Mastery of skill is often defined as reaching a criterion of 80% correct trials and it should be reached at each stage in the hierarchy. Though the stages and criterion are somewhat arbitrary, it is true that our brains need to build a foundation and learn through stages to reach a higher-level skill (Smilkstein, 2003). These studies incorporated these learning theories into their interventions which may have impacted their large treatment effects.

Another challenge in this area of research is the individual differences present in both the patient group and devices employed. Within the population of "AAC user" or people with CCN, there is extreme heterogeneity and therefore it is impractical and unlikely that one treatment design will impact each individual the same way. All of the studies examined were of a case study, single-subject or case series design which allows the researchers to focus on the individual. These designs allow for "identification of intervention adaptations needed to produce intended outcomes" as well as the testing of conceptual theories of behaviour and the conditions under which they change (i.e. learning) (Horner et al. 2005). The five studies took advantage of these designs and provided individualization by creating individual treatment schedules to allow for mastery of skill, different modes of responses to accommodate communicative needs, and different target sounds or words related to the participants' literacy needs. In contrast, the two studies lacked individualized treatment schedules and implemented unsuitable measures which may have negatively impacted the treatment effects as they saw less generalization and skill maintenance (Hanser & Erickson, 2007; Truxler & O'Keefe, 2007).

Overall, these seven papers provide suggestive evidence that with proper incremental, individualized instruction, literacy intervention can have positive effects on literacy development in people who use AAC with CCN.

Future Research Considerations

In order to improve the level of evidence provided by the current literature, the following recommendations for future research should be taken into consideration:

a) There should be separate research completed on literacy intervention for sub-groups within the umbrella population of "AAC user" as there are many reasons why a person may need AAC, which impacts the type of intervention that should be implemented.
b) There is a focus on letter/sound correspondence in the literature and not enough information on higher level literacy skills like reading for comprehension.

Clinical Implications

Speech language pathologists have a pivotal role in supporting the literacy development of people who use AAC. Although a large gap remains in this area of research, these studies provide a helpful starting point of evidence for effective treatment methods, especially for early literacy skills like decoding and word identification. Additionally, these studies provide concrete evidence that people who use AAC *can* learn literacy despite existing stigmas. Speech Language

Pathologists have a responsibility to advocate for this population and share these results with other health care/ education professionals to break these stigmas that may be limiting people who use AAC.

References

Fallon, K., Katz, L. (2008). Augmentative and alternative communication and literacy teams: facing the challenges, forging ahead. *Seminars in Speech and Language*, 29(2), 112-119.

Fallon, K., Light, J., McNaughton, D., Drager, K., Hammer, C. (2004). The effects of direct instruction on the single-word reading skills of children who require augmentative and alternative communication. *Journal of Speech, Language, and Hearing Research*, 47, 1424-1439.

Hanser, G., Erickson, K. (2007). Integrated word identification and communication instruction for students with complex communication needs. *Focus on Autism and Other Developmental Disabilities*, 22(4), 268-278.

Heller, K., Fredrick L., Tumlin, J., Brineman, D. (2002). Teaching decoding for generalization using the nonverbal reading approach. *Journal of Developmental and Physical Disabilities*, 14(1), 19-35.

Horner, R., Carr, E., Halle, J., Mcgee, G., Odom, S., Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Council for Exceptional Children*, 71(2), 165-179.

Johnston, S., Davenport, L., Kanarowski, B., Rhodehouse, S., McDonnell, A. (2009). Teaching sound letter correspondence and consonant-vowel-consonant combinations to young children who use augmentative and alternative communication. *Augmentative and Alternative Communication*, 25(2), 123-135.

Light, J., McNaughton D., Weyer, M., Karg, L. (2008). Evidence-based literacy instruction for individuals who require augmentative and alternative communication: a case study of a student with multiple disabilities. *Seminars in Speech and Language*, 29(2), 120-132.

Machalicek, W., Sanford, A., Lang, R., Rispoli, M., Molfenter, N., Mbeseha, M. (2009). Literacy interventions for students with physical and developmental disabilities who use aided AAC devices: a systematic review. *Journal of Developmental and Physical Disabilities*, 22(3), 219-240.

Smilkstein, R. (2003). We're born to learn: Using the brain's natural learning process to create today's curriculum. Thousand Oaks, Calif: Corwin Press.

Soto, G., Dukhovny, E. (2008). The effect of shared book reading on the acquisition of expressive vocabulary of a 7-year-old who uses AAC. *Seminars in Speech and Language*, 29(2), 133-145.

Sturm, J., Spadorcia, S., Cunningham, J., Cali, K., Staples, A., Erickson, K., Yoder, D., Koppenhaver, D. (2006). What happens to reading between first and third grade? Implications for students who use AAC. *Augmentative and Alternative Communication*, 22(1), 21-36.

Truxler, J., O'Keefe, B. (2007). The effects of phonological awareness instruction on beginning word recognition and spelling. *Augmentative and Alternative Communication*, 23(2), 164-176.