Critical Review: Across all ages of AAC users, do Augmented Input strategies improve communicative outcomes?

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This critical review examines published literature for evidence that providing Alternative Augmentative Communication (AAC) users, of any age, with simultaneous speech and modelling of the AAC (augmented input) would impact communicative outcome. A literature search using computerized databases was completed and resulted in eight articles which met inclusion criteria. Overall, findings indicate that interventions which include communication partner augmented speech strategies result in positive outcomes across a variety of communicative areas. There is compelling evidence for the use of this strategy to teach expressive and receptive understanding of single words in children and adolescents. There is also emerging evidence for the use of Augmented Input strategies in the areas of pragmatics, morphology and syntax in both children and adults with complex communication needs.

Introduction

It is well known, in the Speech-Language Pathology field, that the quality and quantity of "speech models and language interactions" is a crucial component contributing to the success of language acquisition for developing children (Sennot, Light & McNaughton, 2016). Individuals with complex communication needs often require alternative methods for communication, such as a Speech Generating Device (SGD), sign language, or picture symbols, to name a few. These devices can function to give the user a "voice" that replaces or supplements their verbal speech through single or multiple modalities (Beukelman & Mirenda, 2013 as cited by Sennot et al., 2016). More recent understanding of Augmentative Alternative Communication (AAC) proposes that these users have a significantly different experience acquiring the language and communication skills necessary to function in society. They may receive adequate quantity and quality of language input and speech models; however, this input may have less of an impact on their ability to communicate using their AAC system because their modality of output is incompatible with the speech input they receive. This lack of continuity and absence of language modeling in their preferred system for communication can produce detrimental effects on their early communication and language skills, which may affect them in their adult lives (Sennot et al., 2016).

To address these issues, interventions began to emerge that were intended to model language and speech in a way that would be relevant and valuable for the modality of output used by the individual. This method has several variations and names (e.g. Aided Language Stimulation (Goosens, 1989), Aided Language Modeling (Drager et al., 2006), Natural Aided Language (Cafiero, 1998) Aided AAC modeling (Binger & Light, 2007) but is generally referred to as Augmented Input (Romski & Sevcik, 1996). The primary strategy involves the communication partner augmenting their speech by simultaneously modelling the associated symbol or picture in the AAC modality of the individual. This assists the user to associate their expressive modality with the spoken language input, as well as a model of how to use the system to engage in a communicative interaction.

Research on this strategy has produced positive results but is largely related to its use in young children, usually with developmental delays, autism or other congenital disorders. While this is an important age group, many adults in these populations do not have a suitable or functional form of communication.

Objectives

The objective of this paper is to critically evaluate existing literature regarding the effectiveness of various Augmented Input strategies on the communicative abilities (pragmatics, semantics, syntax and morphology) of children and adults with complex communication needs.

Methods

Search Strategy

A variety of computerized databases, including Pubmed, CINAHL, Scholar's portal, and Western's Library database, were searched using the following terms:

(AAC intervention) (children) OR (adults)
(Aided Language Stimulation)

(Aided Language Stimulation) AND (Autism)
(Augmented Input) AND (Developmental Disabilities)
(Naturalistic Language Intervention)

Selection Criteria
To meet inclusion criteria, studies were required to be peer-reviewed and published after the year 2000. They were required to include participants with complex communication needs, little to no functional speech, and the need for more exposure to an AAC system.

Data Collection
Results of the search yielded the following types of research: single-subject (multiple baseline) (5), randomized clinical trial (1), case study (1) and systematic review (1).

Results

Single Subject- Multiple Baseline Design
A multiple baseline design is part of the single-subject design. It involves studying participant data across a baseline period, during intervention and following intervention. The data for each individual is analyzed separately and success is determined based on the behavioural change in each of the subjects. This design is appropriate for a small subject population.

Drager, Postal, Carrolus, Castellano, Gagliano, and Glynn (2006) investigated the effectiveness of Aided Language Modeling (ALM) in improving the comprehension and production of symbols in two preschool AAC users diagnosed with Autism, ages 4:0 and 4:5 (years: months). Both children had significant deficits in functional communication skills (expressive use of fewer than thirty words). Each of the children demonstrated the ability to match and receptively identify items. The intervention took place over five months and included 37 individual sessions with each participant. Novel vocabulary and distractors were presented during a preferred leisure activity. Researchers referred to the novel items four times each, identifying them verbally while simultaneously pointing to the graphic representation on the communication board. Evaluations of their comprehension and production of the words were performed two times per session using appropriate measurement tools.

Appropriate statistical analyses were performed and results indicated that both children experienced an increase in their comprehension and elicited production of the targeted symbols. Comprehension showed greater improvement than production and progress observed across both measures were maintained several weeks after the intervention ended.

Limitations of this study include a small sample size. Despite the limitations, this study provides compelling clinical evidence that the use of ALM, as a form of augmented input, can improve the comprehension and production of language, primarily nouns, in young children with Autism.

Beck, Stoner and Dennis (2009) sought to investigate the efficacy of Aided Language Stimulation (ALS) to increase AAC use during conversational turns for six adults (ages 25-50) with complex communication needs. Of the six participants, four of them had other AAC systems, however, were not using them functionally to interact with novel communication partners. Baseline, intervention and post-intervention, sessions occurred two times a week for approximately 24 sessions lasting 12-13 weeks spread over the course of a year. Participants were presented with pre-made symbol communication boards that corresponded to the structured discussions focused on weekend activities or music. Data were collected each session on the number of conversational interactions (commenting or response to a question) and form of communication used by the participant (e.g. AAC device, gestural, verbal etc.).

Appropriate statistical analysis revealed a modest increase in the number of communicative turns taken using the AAC device. While the results were variable, ALS enhanced these adults' ability to socialize with their peers, and participate more fully in life.

Limitations of the study included small sample size and a lack of descriptions of the participants involved. The results of this study provide suggestive evidence that ALS is an effective method for increasing the use of AAC systems as a method of responding during conversational turns, in adults with complex communication needs.

Harris and Reichle (2004) investigated the ability of three preschool children with moderate cognitive disabilities to comprehend and produce novel vocabulary words (nouns) introduced using ALS. Participants, ages 3:10, 4:2 and 5:4, demonstrated significant deficits in functional communication skills, receptive skills, and normal hearing and vision. Four target objects and accompanying symbol representations were created for each child and

activity. The intervention period was conducted during a preferred play activity for the child, while the experimenters followed a scripted routine. Experimenters named the novel objects while simultaneously pointing to the representing symbol four times each. Appropriate measurement tools were used to assess the skills of the participants during baseline, intervention and post-intervention periods. All participants maintained their level of performance in post-intervention probes and required less sessions in stages two and three, to reach criteria for comprehension and production of the target symbols.

Appropriate statistical analysis yielded evidence that ALS promotes comprehension and production (labelling) of objects in young children with moderate cognitive disabilities and limited functional speech.

The study was limited by the small sample size. Despite this, the results of the study provide compelling evidence concerning the use of ALS as a form of AI to expand the receptive and expressive single word vocabulary for children with moderate cognitive disabilities.

Dada and Alant (2009) conducted a study to determine the effectiveness of ALS on increasing the comprehension of vocabulary in children (ages 8:0-12:1) with little to no functional speech (LNFS). All four participants had been previously diagnosed with Down Syndrome or Cerebral palsy, had normal hearing and fewer than 15 intelligible words. During a three-week group intervention period, 24 words were targeted. Depending on the theme of the activity, a specific set of nouns and/or concept words (e.g. more, less, same and different) were presented verbally and graphically 3-5 times during associated session. Comprehension probes were completed three times a week and data were collected on their understanding of the word (e.g. which one is different?)

Appropriate statistical analysis revealed an increase in the receptive acquisition of new vocabulary words for all participants when ALS was used during meaningful experiential activities.

Limitations of the study included a small sample size, limiting the generalization of the methods used in this study to other children with LNFS. Regardless, this study presented compelling clinical evidence for the use of ALS to promote vocabulary understanding in children with disabilities and LTFS.

Solomon-Rice and Soto (2014) compared the effectiveness of Focused Stimulation (FS) and AI intervention methods in improving the independent expressive vocabulary output of three children under the age of three. Each participant presented with moderate, mild or no cognitive delays, deficits in their functional communication skills, and normal hearing and vision. Intervention type was randomly assigned before each session to minimize order effects. For each participant, 20 developmentally appropriate novel vocabulary targets (10 for each condition) were chosen and graphic representations were mapped onto the participants pre-existing AAC systems. Depending on the intervention method, the experimenter verbally produced (FS) or verbally produced and pointed to the accompanying target icon (AI) 10 times during each condition. Each intervention extended for 12-24 sessions, with duration dependent on when the participant met the pre-determined learning criteria. Data was collected on autonomous productions of the target vocabulary regardless of the mode or the context of production (spontaneous, imitated, response to a question/choice) throughout each session using appropriate measurement tools.

Appropriate statistical analysis of the data indicated an increase in independent productions of words (nouns, verbs and adjectives) in both the AI and FS conditions for all participants. Limitations of the study include a small sample size. Despite the limitations, this study provides compelling clinical evidence that both AI and FS can influence the production of new vocabulary words in children with LNFS under the age of three.

<u>Randomized Clinical Trial Design</u>
This design is used to make a comparison between groups to which participants have been randomly assigned. It allows for more controlled understanding of the cause and effect relationships of the specific independent variables under review.

Romski, Sevcik, Adamson, Cheslock, Smith, Barker, and Bakeman (2010) sought to compare the effectiveness of AI, augmented output (AO), and spoken communication (SC) when presented by parents to increase vocabulary production in children with developmental delays and LNFS. A total of 62 children, ages 21-40 months, and their parents were randomly assigned to one of the intervention groups for the duration of the 24 intervention sessions. Novel vocabulary words appropriate to the home environment and interests of the child were naturally modelled at least one time in each session. Parents and interventionists appropriately administered the

intervention assigned to them. With the exception of the AI condition, AO and SC conditions required that the interventionist/parent prompt the child to repeat the target word they modelled. The AI group used expectant pausing to encourage production. Appropriate measures were used to track and analyze the spontaneous spoken and augmented output of the participants.

Appropriate statistical analysis of the data was preformed and results indicated that AI and AO interventions yielded results consistent with the model they were provided. For example, those in the AO condition who were required to activate the device during intervention used their AAC device more often and the AI condition used a combination of spoken and AAC to communicate, as they had seen modelled to them. When combined, augmented and spoken vocabularies were considered, AO and AI had a larger vocabulary than the SC group.

Limitations of the study includes potential difficulties generalizing results to children of parents that are less educated and lacking the availability of the parents in this study. Despite these limitations, this study had a strong research design and provides compelling clinical evidence for the use of AI and AO as an intervention to improve production of language for young children with developmental delays and LNFS.

Case Study Design

A case study is a non-experimental design which describes a patient, their disorder, and treatment outcomes following an intervention. Due to their single sample size, generalization is limited, however they can help direct further research.

Cafiero (2001) described the treatment effects of a natural aided language (NAL) approach to increase the communication using an AAC system in a 13-year-old adolescent with Autism. The participant had a limited sound repertoire, lacked a functional mode of communication, and exhibited significant behaviours that were disruptive to his environment and dangerous to his health. NAL was introduced to expose the participant to a new language system presented naturally throughout his school day. The SLP, teacher and EA verbalized a word while simultaneously pointing to it on his communication board. Language boards used included icons with describing words, “yes” and “no” and nouns. Across the 22-month intervention period, appropriate measurement techniques were used to collected data on his spontaneous use of the communication boards for commenting, questioning, initiating and responding to communication partners.

Results of the study indicated an increase in the participant’s expressive vocabulary size (one-word), multi-symbol phrases (syntax) using AAC. Additional positive effects were seen in academic skills and behavior when the intervention was implemented continuously.

By design, a limitation of the case study is sample size. Despite this, the study provides suggestive clinical evidence for the use of NAL as an intervention to increase the generalization of and use of an AAC system for individuals with Autism.

Systematic Review

A systematic review asks a specific clinical question, does a broad search of clinical databases for studies that will fit the predetermined parameters and then synthesizes the information to answer the question. Systematic reviews can include the biases of the author if, for example, important research is excluded because it was published several years ago, or the studies contradict the personal beliefs of the author (Cipriani and Barbui, 2006).

Sennot, Light and McNaughton (2016) completed a systematic review of the effects of interventions that involved AI on improving language acquisition of individuals with complex communication needs. A two-part inclusion criterion for articles included: English, peer-reviewed journal articles between 1989- 2013 and treatment that included a form of AI in natural communication interactions.

An electronic search of three different databases with a clearly defined search strategy was used to find articles. Articles were independently analyzed by two different people using a checklist of methodological elements. Given the study design, the search method used was appropriate. There was no information provided on the blinding (is it supposed to be blinding?) of author names, institutions, or journals of publication during the review. The search revealed nine single case-study designs and one group study design. Participants of the studies ranged in age from 2-12 years old and presented with various disabilities. Appropriate measures of data extraction were used.

Analysis of the data revealed that all interventions were effective and participants demonstrated a gain in performance in the areas of comprehension, production, syntax and pragmatics (social use of language), morphological skills.

Limitations of the study include an unequal representation of disability groups, age and language ability resulting in a restricted data set represented. Even so, this review provides compelling clinical evidence for the use of AI as an intervention to improve upon a variety of communication skills in children with complex communication needs.

Discussion

This review analyzed eight studies to determine the efficacy of AI as an intervention to improve a range of communicative outcomes for AAC users. Although there is some variation in the clinical importance and validity of the studies reported, the overall data suggests that the use of AI strategies results in more effective communication by AAC users. Communication effects were demonstrated in the reviewed studies in various ways including an increase in:

- Production of single word responses (Harris & Reichle, 2004; Drager et al., 2006; Romski et al., 2010; Solomon-Rice & Soto, 2014; Cafiero, 2001),
- Comprehension of single vocabulary words (Harris & Reichle, 2004; Drager et al., 2006; Dada & Alant, 2009),
- Conversational turn taking (Beck, Stoner & Dennis, 2009; Cafiero, 2001; Kent-Walsh, Binger, & Hashamn, 2010 & Rosa- Lugo & Kent-Walsh, 2008 as referenced by Sennot et al., 2016),
- Combination of symbols to form multi-symbol responses, therefore increasing length of utterance (Cafiero, 2001, Binger & Light, 2007, Binger, Kent-Walsh, Berens, Del Campo & Rivera, 2008; Binger, Kent-Walsh, Ewing & Taylor, 2010 as referenced by Sennot et al., 2016).
- Construction of words using appropriate morphemes, such as, marking tenses, plurals and possessives (Binger, Maguire-Marshall & Kent-Walsh, 2011 as referenced by Sennot et al., 2016).

Overall, there is compelling evidence for the use of AI to increase comprehension of single word vocabulary and production of single words using their AAC systems. The remaining areas represented in the review provide preliminary evidence and potential indicators for the use of this strategy to improve conversational turn taking, length of utterance, and appropriate use of morphemes to construct words.

The relative consistency of the findings in the present review are all the more compelling given the range of treatment presentations used to deliver the AI. For example, some studies used a structured presentation of AI, ensuring input included a variety of communicative functions and intervention was conducted across a set number of sessions (Harris & Reichle, 2004; Dada, 2009; Beck et al., 2009). Others used a more naturalistic presentation where modelling of targeted skills were provided during child directed play or throughout the activities of the day (Drager et al., 2006; Romski et al., 2010; Solomon-Rice & Soto, 2010; Sennot et al., 2016 & Cafiero, 2001).

Another remarkable finding is the range of treatment durations observed, with some studies showing benefits from as little as 3 weeks of intervention (Dada, 2009). Even the study with the longest duration, 22 months, reported incremental improvements throughout the intervention period (Cafiero, 2001).

Additionally, AI strategies were used across a range of individuals with additional needs besides speech and language delays. There is strong evidence for the use of AI for those with physical or intellectual developmental disabilities, such as, Autism (Drager et al., 2006; Cafiero, 2001) Down Syndrome and Cerebral Palsy (Dada & Alant, 2009). There is primitive evidence to suggest this method is also effective for those with delays in only speech and/or language (Solomon-Rice & Soto, 2014).

The studies presented in this review also included a large age range, from children 21 months of age to 50-year-old adults (Romski, 2010; Beck et al., 2009). Compelling evidence was provided for the use of AI to improve communication using AAC for the children in these studies between the ages of 21 months and 12 years old. However, the studies that included adolescent to adult aged participants were limited by their small sample size or lack of participant descriptions. Therefore, more research is needed to support the use of AI in the adult AAC user population.

Despite these differences in method, duration of treatment, age and physical or intellectual needs of the participants, positive outcomes were observed across all studies in this review. This suggests that the principle of AI transcends these factors and results in more effective communicative outcomes for all AAC users involved.

Clinical Implications

Overall, the evidence supports the use of AI as an intervention strategy for AAC users. Evidence

presented in this review demonstrates that Augmented Input could lead to improvement in a variety of communicative outcomes for AAC users. Because of the wide variety of ages, disabilities, strategies and treatment durations this strategy can be used with, it is imperative that we continue to study this intervention method, to determine which method and treatment duration will be most beneficial to improve communicative functions in individuals of varying ages and needs. Specifically, future research should address the use of AI for AAC users 13 years old and above, as well as the effect of AI to model appropriate turn taking, as well as, word and sentence construction.

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