Critical Review:

Do speech-generating devices (SGDs), when combined with naturalistic teaching methods promote communication in children with Autism Spectrum Disorder (ASD)?*

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This critical review examines the current research regarding whether the use of a speech-generating device (SGD), increases spontaneous communication in children with Autism Spectrum Disorder (ASD) when taught by naturalistic teaching methods. A systematic literature search using electronic databases yielded five articles in accordance with selection criteria. All studies were single subject designs. Research results indicate suggestive evidence that SGDs, when taught using naturalistic methods, can increase the frequency of spontaneous communicative behaviours in children with ASD. Clinical implications, conclusions and recommendations for further research are discussed.

Introduction

Autism Spectrum Disorder (ASD) is a developmental disorder where individuals present with: deficits in social communication and social interaction; restricted or repetitive behaviour; and communication impairment (American Psychiatry Association, 2013; Sigafoos, O'Reilly, Lancioni, & Sutherland, 2014). Children with ASD develop limited speech, language and functional communication abilities (Sigafoos et al., 2013; Van der Meer & Rispoli, 2010). Instead, these children tend to rely on more pre-linguistic behaviors such as pointing (Van der Meer & Rispoli, 2010).

The speech and language difficulties seen with ASD make these individuals strong candidates for augmentative and alternative communication (AAC). AAC refers to a practice, which aims to supplement or replace natural speech (Van der Meer & Rispoli, 2010; Reichle, Beukelman, & Light, 2002). A subset of AAC is the use of speech-generating devices (SGDs). SGDs are portable low or high tech devices that will produce recorded digitized or synthesized speech (Sigafoos et al., 2013, and Reichle et al., 2002). Graphic symbols are used within an SGD's display to represent the synthesized speech being heard by the listener (Reichle et al., 2002). This voice output has made SGDs a prominent communication option for many children with ASD (Van der Meer & Rispoli, 2010).

To date, drill-based approaches are most commonly used when teaching a child with ASD how to use an SGD (LeBlanc, Esch, Sidener, & Firth, 2006). Although effective, drill training is limited to teaching simple requesting. It is argued to limit the potential expansion of communication (Van der Meer & Rispoli, 2010). In contrast, naturalistic teaching approaches have been shown to facilitate more complex communication in children with ASD (LeBlanc et al., 2006). Naturalistic teaching methods teach communication skills through using opportunities present in a child's social and physical environment (Van der Meer & Rispoli, 2010). These methods have also been shown to demonstrate generalization of communication skills in children with ASD; however, the majority of this research has not incorporated those who also use an SGD (Van der Meer & Rispoli, 2010). With the recent increase in the prescription of SGDs for children with ASD, it is important to determine if naturalistic teaching principles can be applied to the use of SGDs (Van der Meer & Rispoli, 2010).

Objectives

The primary objective of this paper is to critically evaluate the existing literature regarding whether the use of speech-generating devices, as taught by naturalistic teaching methods, has an effect on promoting communication in children with ASD. The secondary objective is to propose evidence-based clinical implications for use of this intervention with this population.

Methods

Search Strategy

Systematic searches were conducted using a number of online databases including PubMed, Linguistics and Language Behaviour Abstracts (LLBA),

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PsychINFO, Education Resources Information Center (ERIC) and Google Scholar.

The following search terms were used:

(Speech-generating devices OR SGD)
AND (naturalistic teaching)
AND (Autism Spectrum Disorder OR ASD)
AND (communication OR oral communication)

Selection Criteria

To be included in this review, studies had to include children (under age 18) with a diagnosis of ASD without any concurrent diagnoses. Intervention was defined as using a naturalistic teaching method to teach the use of an SGD. SGDs used in all studies were required to produce voice output when activated through touching individual picture plates with corresponding visual or orthographic symbols. The studies also had to include spontaneous communication behaviours (however defined) as the dependent variable. No limitations were placed on research design, outcome measures, and publication year. The search was limited to English-language publications.

Data Collection

The literature search revealed five studies that met the above selection criteria. All studies were single subject designs following an AB multiple baseline design across participants. Evidence was evaluated using a scale for single-subject research designs developed by Logan, Hickman, Harris, and Heriza (2008). A Level I reflects the highest level of evidence, whereas a level V reflects the lowest level of evidence (Logan et al., 2008).

Results

Single Subject Designs

The objective of each study was to measure potential changes in the frequency of communicative behaviours as compared to each participant's baseline measures. Furthermore, the variable characteristics found in the ASD population allow patients to act as their own control (Logan et al., 2008). Thus, the use of single subject designs is appropriate. Interpreting results from this design must be done with caution due to possible selection biases, and small sample sizes. These factors affect the amount of population-based evidence that can be extrapolated from study subjects to imply a treatment effect.

Schepis, Reid and Behrmann (1998) investigated the effects of SGD use, modeled by naturalistic teaching procedures, on communicative interaction in four children (aged 3-5 years) with severe ASD. All children were enrolled in a classroom for children with ASD. The classroom teacher and three educational assistants were trained on how to naturally model the use of the selected SGD (the Cheaptalk), through child-preferred activities, and expanding on child initiated responses. Outcome measures included frequency and appropriateness of communicative behaviours and were recorded during playtime for all subjects, and during snack time for two of the subjects. Results revealed that naturalistic teaching with an SGD increased the frequency of communicative behaviours in children with ASD.

Schepis et al.'s (1998) study demonstrated strength by using rating scales to effectively match participants, in order to better compare intervention effects and validity across subjects. Furthermore, there was consistent use of probe and contextual rating data throughout both baseline and intervention in order to determine an intervention effect. However, the SGD was not present during baseline. The SGD only being present during the intervention may have caused a possible novelty effect facilitating the increases reported for unprompted SGD use for communication. Furthermore, since only two of the four participants received intervention in two contexts, the statistical power of the reported intervention effect decreases. Although appropriate visual inspection of the results was conducted, the researchers did not conduct a statistical analysis to determine significance or effect size. Statistical analysis would have further supported an intervention effect. The level II evidence (Logan et al., 2008) presented in this study is suggestive based on the limitations outlined.

Olive, et al., (2007) investigated the effects of enhanced milieu teaching (EMT) with an SGD (the CheapTalk 4) on the independent use of requesting during play activities in three children (age 3-5 years) with severe ASD. Two of the three children participated in classrooms strictly designated for children with disabilities, and all children received support from a teacher or educational assistant specializing in special education. EMT procedures used most-to-least prompts in order to elicit correct requests using the SGD during baseline and intervention. Results indicated increases in SGD use for requesting, as well as gestural and verbal communication.

The study by Olive et al. (2007) demonstrated strengths by including a well-defined set of inclusion criteria, as well as controlling for the setting and intensity of intervention. Furthermore, the study contained clearly identified operational definitions

for requesting, allowing for strong inter-rater reliability (86-100%).

Although there was a well-established set of inclusion criteria, participants were not matched for the amount of previous intervention received by a Speech-Language Pathologist (SLP). This could have influenced how responsive and compliant each child was to the presented intervention. Additionally, no statistical analysis was applied to the results to determine significance or effect size, which would have further supported visual inspection. With the outlined strengths and weaknesses considered, the level II evidence presented in this study is considered suggestive.

Trembath, Balandin, Togher, and Stancliffe (2009) compared the effectiveness of peer-mediated naturalistic teaching both with and without the use of an SGD (the Talara 32) on increasing the frequency of communicative behaviours for three children with ASD (age 3-5 years). Six peer mediators (age 3-5 years) were educated on modeling SGD use during 10-minute classroom play activities during baseline. Frequency of communicative behaviours was recorded for each child with ASD during intervention. In addition, generalization probes were conducted during mealtime in both baseline and intervention phases. Results indicated that communicative behaviours when using an SGD and naturalistic teaching demonstrated a greater increase than naturalistic teaching without an SGD; however, the extent to which these increases were maintained varied between participants.

Trembath et al. (2009) demonstrated strengths by controlling for setting, and developing a method for consistent peer training. Additionally, the study performed statistical analysis for significance and effect size using the Percentage of All Non-Overlapping Data (PAND) and the Pearson Φ. These measures allowed for all intervention data to be compared to all baseline data, in order to support the intervention effect demonstrated by visual inspection. Generalization probes also allowed for the demonstration of the carryover of treatment effects. A weakness of this study is that it did not state the severity of the disorder for each child with ASD, which affected comparison across subjects. Additionally, despite the fact that the authors had a well-established method, unexpected prompting and interference by the classroom teacher was reported to occur during both baseline and intervention. Prompting creates potential bias in the frequency of communicative behaviours by the children with ASD. The level II evidence (Logan et al., 2008) presented in this study is suggestive based on the limitations outlined.

Trottier, Kamp and Mirenda (2011) investigated whether peers could be taught to support SGD use in social game routines, and if peer support demonstrated an increase in spontaneous appropriate communicative behaviours using an SGD in two children (age 11 years) with ASD. For the purpose of this review, only the findings regarding SGD effects on the communicative behaviours of the participants with ASD were examined. Experimental objectives were examined in two consecutive intervention phases. Peer mediators (age 11-12 years) were trained on modeling and facilitating the use of an SGD (the Vantage Lite and the Springboard Lite) during social games requiring player turns. Frequency of communicative behaviours (e.g. activation of SGD, vocalization etc.) was recorded during intervention. Results were mixed as to whether SGD use increased communicative behaviours in the children with ASD, due to an increase in communicative behaviours for one child but not the other.

Trottier et al. (2011) demonstrated strengths in controlling for treatment intensity, play activity and facilitator prompting. This decreased potential effects of nuisance variables influencing the increase in communicative behaviours. This study also included a measure for treatment fidelity to ensure that each component of intervention was delivered in a comparable manner to both participants. Inter-rater reliability and treatment fidelity were strong at 96% and 93% respectively. Appropriate statistical analysis was conducted using the Percentage of Non-Overlapping Data (PND) to determine a high level of change from baseline to intervention. Another weakness of this study is that the use of just two participants hindered the demonstration of a functional relationship between intervention and an increase in communicative behaviour. This weakness in combination with the outline strengths provides suggestive evidence for this level II study (Logan et al., 2008).

Thiemann-Bourque (2012) investigated the effects of using peer-mediated teaching when combined with PECS on increasing spontaneous communication in four preschool aged children with ASD. Thiemann-Bourque (2012) also investigated peer-mediated teaching to model the use of an SGD on increasing spontaneous communication for three preschool aged children with ASD. For the purposes of this review, only the findings regarding SGD effects on the communication of the participants were examined. Peer mediators were trained using a modified published peer-training program called “Stay-Play-

Talk". Frequencies of communicative behaviours for each child with ASD were recorded during play activities where classroom teachers used a least-to-most prompting hierarchy to encourage peer interaction. Results indicated an increase in communicative behaviours in all participants with ASD that used the SGD.

Thiemann-Bourque's (2012) method, "Stay-Play-Talk," ensured that each component of intervention was delivered in a comparable manner to all participants, although a measure of treatment fidelity was not recorded. This method potentially decreased the amount of bias and prompting by teachers during the intervention phase. This study also posed a number of weaknesses. A lack of participant data, inter-rater reliability, and statistical analysis to determine significance or effect size, made it difficult to determine the level of support for the stated results. Furthermore, although increases in frequency of communicative behaviours were reported from baseline, the report is not accompanied by any charted or graphic representation. Lack of visual representation also does not allow for stability of baseline data to be confirmed in order to support the claimed effectiveness of intervention. The level II evidence (Logan et al., 2008) presented in this study is equivocal based on the limitations outlined.

Discussion

The overall commonalities in the findings of the reviewed articles are suggestive that SGD use, when taught with naturalistic teaching methods, can increase communication in children with ASD. The AB multiple-baseline designs used are appropriate given the heterogeneity of the ASD population. Furthermore, the designs are suitable given that the goal of all researchers was to investigate and compare immediate effects of a treatment in a single subject. This reflects an overall increase in experimental validity. High rates of inter-observer agreement and procedural integrity in most of the studies also contribute to experimental reliability.

Furthermore as seen in the study by Trottier et al. (2011), instances of qualitative report further contribute to the evidence base for experimental findings. Trottier et al., 2011, reported the children with ASD in the study: continued to seek out their peer mediator after the cessation of treatment for conversation; were able to continue to play the social games using their SGD; and continued to produce social comments using their SGD. Although this information is promising for potential maintenance of intervention effects, it is anecdotal in nature and should therefore be treated with caution.

Limitations within the reviewed studies include the participant criteria of ASD being too broad to produce clear conclusive results across all participants in all studies. For example, the studies by Trembath et al. (2009), Trottier et al. (2011), Thiemann-Bourque (2012), do not include a level of severity for each participant's diagnoses of ASD. Had all studies narrowed their criteria by including the severity of ASD of their participants, they may have produced more conclusive results to support a treatment effect.

The reviewed studies were limited by small sample sizes, which reduce the likelihood of demonstrating a true intervention effect, as cautioned by Trottier et al. (2011). Small sample sizes also limit the potential for generalization and extrapolation of results to the larger population. However, it should be noted that it is difficult to find enough participants meeting the criteria for the given population of study.

The studies by Schepis et al., (1998), and Olive et al., (2007), had adults implementing the naturalistic methods to facilitate SGD use for communication. The adult modeling of an SGD demonstrated slightly more consistent results for increases in communicative behaviours, as compared to the remaining three studies, which used aged-matched peer models. Inconsistencies seen between the results of the peer-mediated studies could be attributed to the normal variation in the skills of typically developing peer mediators. As reported by Trembath et al., (2009), although peer mediators were willing to model SGD use, they became easily distracted by other activities in the classroom. In contrast, trained adult mediators were less likely to experience these difficulties. Although adult direction may appear to be more consistent when facilitating SGD use, there is still a lack of treatment fidelity across the reviewed studies in order to reliably and validly support the proposed interventions and outcome measures.

Most studies reported increases in spontaneous communicative behaviours both with and without an SGD. Therefore, using naturalistic teaching methods to teach the use of an SGD was not shown to decrease non-SGD communication skills. However, since not all of the studies demonstrated consistent positive outcomes across participants, along with conclusive evidence in relation to experimental design, these findings should be interpreted with caution (Logan et al., 2008). The reviewed works present preliminary findings that naturalistic teaching for SGD use may facilitate a much-needed transition

from prelingusitic skills to more advanced communication skills (i.e. commenting, questioning and conversational turn taking).

Conclusion

Overall, using naturalistic teaching methods to teach the use of SGDs has the potential to increase communicative behaviours in children with ASD. The evidence can be described as suggestive. Further research is needed to provide greater experimental validity and fidelity. Application to different routines throughout a child's day should also be investigated. Furthermore, research comparing two types of naturalistic teaching within the same study may be warranted to determine if one method shows a greater treatment effect over another, for more enhanced clinical decision-making.

Clinical Implications

Goals for children with ASD usually target both communication and social interaction skills. These same goals still apply to those who use an SGD. The voice output provided by an SGD also makes it conducive to social interaction. Given these factors, interventions focused on providing natural support for each of these skills is valuable and could be incorporated into teaching the use of an SGD.

This teaching may be more optimal when completed by an adult (i.e. parent teacher and/or educational assistant). Adult mediators have more control over the learning environment, and therefore can prompt appropriate use of a device during a child's social and physical routines. Further research is required to address the challenge of establishing a method with high treatment fidelity to ensure reliable replication of the method in the clinician's absence.

References

American Psychiatric Association. (2013). Diagnostic and Statistical Manual of Mental Disorders (5th ed.) Washington, DC.

LeBlanc, L. A., Esch, J., Sidener, T. M., & Firth, A. M. (2006). Behavioral language interventions for children with autism: Comparing applied verbal behavior and naturalistic teaching approaches. *The Analysis of verbal behavior*, *22*(1), 49.

Logan, L. R., Hickman, R. R., Harris, S. R., & Heriza, C. B. (2008). Single-subject research design: recommendations for levels of evidence and quality rating. *Developmental medicine & child neurology*, *50*(2), 99-103.

Olive, M. L., de la Cruz, B., Davis, T. N., Chan, J. M., Lang, R. B., O'Reilly, M. F., & Dickson, S. M. (2007). The effects of enhanced milieu teaching and a voice output communication aid on the requesting of three children with autism. *Journal of Autism and Developmental Disorders*, *37*(8), 1505-1513.

Reichle, J., Beukelman, D., Light, J. (2002) Exemplary practices for beginning communicators: Implications for AAC. Baltimore, MD: Paul H. Brookes Publishing Co.

Schepis, M. M., Reid, D. H., Behrmann, M. M., & Sutton, K. A. (1998). Increasing communicative interactions of young children with autism using a voice output communication aid and naturalistic teaching. *Journal of Applied Behavior Analysis*, *31*(4), 561-578.

Sigafoos, J., O'Reilly, M. F., Lancioni, G. E., & Sutherland, D. (2014). Augmentative and alternative communication for individuals with autism spectrum disorder and intellectual disability. *Current Developmental Disorders Reports*, (Early Online Access).

Thiemann-Bourque, K. (2012). Peer-mediated AAC instruction for young children with autism and other developmental disabilities. *SIG 12 Perspectives on Augmentative and Alternative Communication*, *21*(4), 159-166.

Trembath, D., Balandin, S., Togher, L., & Stancliffe, R. J. (2009). Peer-mediated teaching and augmentative and alternative communication for preschool-aged children with autism. *Journal of Intellectual and Developmental Disability*, *34*(2), 173-186.

Trottier, N., Kamp, L., & Mirenda, P. (2011). Effects of peer-mediated instruction to teach use of speech-generating devices to students with autism in social game routines. *Augmentative and Alternative Communication*, *27*(1), 26-39.

Van der Meer, L. A., & Rispoli, M. (2010). Communication interventions involving speech-generating devices for children with autism: A review of the literature. *Developmental Neurorehabilitation*, *13*(4), 294-306.