Critical Review: Which Design Overlay is Better Suited for Early Assisted AAC Intervention in Preschoolers: Visual Scene Displays or Traditional Grid Layouts?

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

This critical review examines the effect of AAC assisted device screen layout on the ability of preschool children to access vocabulary. Specifically, this review compares the success of young children when using a speech generating device containing either a traditional grid organizational display, where vocabulary items are organized in a square grid pattern of discrete icons, or a Visual Scene Display (VSD), where vocabulary items are imbedded in a contextual scene. Study designs reviewed include 3 original research studies, 1 forum note, and 2 expert opinion articles. Results are inconclusive.

Introduction

Current research indicates that early Augmentative and Alternative Communication (AAC) intervention for children with complex communication needs is crucial for helping them develop language during the early stages of development when language learning typically accelerates. However, as Drager, Light, Speltz, Fallon and Jeffries (2003) indicate, current designs of AAC technology are generally designed to fit the learning style and cognitive needs of typically-developed adults. As a result, the options available for children do not facilitate learning by minimizing cognitive demands. It is generally acknowledged that AAC devices should offer maximum communication power at a minimal cost of learning. That is, the design of the AAC system itself should not act as a barrier to language learning, but be as closely tailored to the learning styles and cognitive abilities of young children as possible. Design of AAC technologies has become particularly relevant due to the recent, rapid expansion and evolution of technology behind assisted devices, and as a result there are many high tech speech generating devices available to parents and therapists. Some involve a static display, containing a fixed number of pre-determined icons on one screen. Others involve a dynamic display, which allows for a larger number of vocabulary screens to be accessed via a central menu. With the increasing number of options available, it is important to ensure that these devices are designed to accommodate the needs of various populations, including preschoolers.

Some researchers suggest that navigation through a visual scene display (VSD) is more easily learned by very young children, as it places vocabulary into visual context that may help with recognition (Drager, et al., 2003). For this reason, it has been argued that placing vocabulary within this type of display rather than in a grid arrangement would facilitate language learning in preschool children (Drager et al., 2003). However, it has also been pointed out that for children with disabilities, VSDs may provide additional difficulties, as they are more visually complex than items equally spaced on a grid. Children with motor restrictions may also have difficulty accessing vocabulary in a VSD because the lexical items are embedded within the visual scene and not in large discrete squares (Drager et al., 2003). When providing AAC intervention for a young child, it would be important for Speech Language Pathologists to recommend supports and devices that incorporate systems that are easily learned by this population in order to maximize their communicative potential. The organization of vocabulary within an assistive device may then play a key role in maximizing a child's learning potential within the critical time period of language learning.

Objectives

The primary objective of this paper is to critically evaluate the existing literature regarding the impact of Visual Scene Displays and traditional grid displays on preschool learning and device use. The secondary objective is to provide clinical recommendations on the best-suited AAC design for preschoolers for use in early intervention strategies.

Methods

Search Strategy

Articles were found using the computerized data bases PubMed, CINAHL and PsychINFO. Keywords were: [(AAC) and (preschool)* or (child*)]

Selection Criteria

Studies were selected that were written in English and compared VSDs and grid display overlays in children ages four and under.

Data Collection

Results of this literature search yielded six papers that met selection criteria. Three of the papers were original research, two were expert opinion papers, and one was a forum note.

Results

Drager, Light, Speltz, Fallon and Jeffries (2003) conducted a randomized clinical trial of 30 typically developing preschoolers aged 2;5 to 2;11 years that sought to examine the learning demands of 3 different AAC dynamic display screen layouts on vocabulary learning in a play context. The layout conditions were: taxonomic grid (vocabulary organized in hierarchical categories); schematic grid (vocabulary organized according to event); and schematic scene organization (VSD). All children were determined to be typically-developing based on teacher and parent report, and gender and age were controlled within each group.

ANOVAs were appropriately used to evaluate the effect of system organization, sessions, and vocabulary type. Their results showed that system organization was statistically significant, with appropriate post-hoc t-tests indicating that children using schematic scene systems and schematic grid systems both performed better than those using taxonomic grids. The effect of system organization on generalization was not significant. However, considering the small number of learning sessions (4), and lack of everyday practice in using the device, it is unlikely that generalization would have occurred. In general, children performed poorly across all systems, with the researchers suggesting that the dynamic aspect of the AAC devices may have been too challenging for the children.

The study's limitations included the lack of inclusion of the population for which the AAC devices are intended: children with disabilities that may include cognitive, sensory, motor and other impairments, making it difficult to generalize these results to the intended clinical population. Also, the small number of learning sessions would likely not replicate the therapeutic use of a device if being introduced to a preschool child in early intervention. Additionally, the number of vocabulary items included likely limited the information gained, as it seems unrealistic to expect 2 ½ year old children to quickly be able to learn the location of 24 of 60 words located within a novel system on an unfamiliar device. Most problematic is the authors' conclusion that the VSD condition was best. While the children in both VSD and schematic grid conditions performed better than children using the taxonomic grid, there was no statistical difference between the VSD and the schematic grid. Therefore, it cannot be concluded that VSDs are more suitable for 2 ½ year olds than schematic grids, but rather than both are viable options for this population.

In 2004, Drager et al. performed a similar study, this time with 3-year-old participants, in order to further investigate the influence of menu page layout on performance of children using dynamic display devices. The participant number and selection was identical to the 2003 study, with the mean age of participant 3;6. Learning of 61 vocabulary items in 3 displays was assessed over 4 sessions (with the last separated by 2 weeks). Displays were grids assessed via either contextual scene menu, screen shot grid menu, or single symbol grid menu.

As with the previous study, 61 vocabulary items were chosen, with one used as an example. Eighteen items were chosen for instruction, and 18 for generalization. Appropriate t-tests revealed significantly better performance in the contextual scene over the other 2 displays in the second session. However, after the second session, performance in both the contextual scene and grid screen shot was significantly better than in the single symbol grid, with no significant difference the contextual scene and the grid screen shot.

Shortcomings of this study include the large number of vocabulary items, and small number of learning sessions, considering the novelty of the device for the children. This results in a learning situation where it seems unlikely that the children would become proficient enough with any of the device formats to provide informative results upon which to base a treatment recommendation. Most problematically, the authors conclude that the contextual scene condition resulted in significantly better performance; however examination of their results shows that this was only the case in the second session. For the remaining two sessions, children in both the contextual scene and the screen shot grid conditions performed significantly better than the single symbol grid, with no significant difference between the contextual scene and screen shot grid conditions. Therefore, these outcomes suggest it cannot be concluded that contextual scenes are better suited for this population, but rather either contextual scene menus or screen-shot grid menus may be best on dynamic displays intended for 3 year olds.

In a mixed clinical trial, Jackson, Wahlquist and Marquis (2011), examined the effect of two types of static overlay design on a speech generating device during a shared book reading with preschoolers. The participants were 39 children (mean age 4;1), 13 of whom had complex communication needs (CCN) (mean age 3;8). The children in this group varied greatly in regards to etiology, and were not balanced for gender. Therefore the results between the typically-developing and CCN children were not statistically analyzed. Results from appropriate t-tests indicated that in spontaneous activations during free play, the number of activations using the grid overlay was significantly higher. While the number of accurate responses of closed-ended questions was higher for the CCN group using the VSDs, the effect of grid display did not reach

significance for either group. However, when answering open-ended questions, children with CCN activated the device with significantly greater frequency when using the grid overlay. VSDs were also associated with significantly higher "silent hits" (unsuccessful attempts to activate the SGD) for both groups of children, especially the CCN group.

The inclusion of children with CCN in this study is a strength, as this is the clinical population who will ultimately be using these devices to communicate. A larger sample size for both typically developing and children with CCN groups, balanced for age and gender, as well as a larger number of question tasks would have provided more information, and may have allowed for more statistically conclusive results. More research into the "silent hits" would also have been beneficial. The authors suggest that a combined clinical approach may be most useful, such as introducing new vocabulary using a grid system, and discussing the story with the child using a VSD. However, ultimately, the study suggests that statistically, VSDs do not have a benefit over grid displays, and that both grid and VSD overlays would be appropriate for preschoolers during shared reading.

Light and Drager's 2002 expert paper summarizes what was known at that time about young children and AAC technologies, and that discusses future research priorities in this area. In the area of VSDs and grid layouts, they emphasize the potential meta-linguistic demands imposed by grid layouts as language concepts are taken out of context. As a result, they suggest that VSDs are intuitively a preferable choice over grids, although they are limited in their representation of abstract terms and may not support generalization. Their summary of current research appropriately indicates that, at the time, the only study available in this subject within the preschool population was their own study on 2 ½ year olds. However, they misleadingly state that children learned vocabulary faster and were more accurate when using a VSD layout. As previously discussed in this critical review, this is not the case, as no statistical difference was found between schematic grid and VSD layouts. While the authors are well-informed researchers in their field, this calls into question the validity of their argument in favour of VSDs, as there is no evidence to support their claim.

Light and McNaughton's (2012) expert paper summarizes current scientific findings regarding AAC and the needs of children with CCN, and suggests directions for future research and development. In the section discussing AAC screen organization, the authors adapt the standpoint that VSDs, in particular those composed of digital photographs taken of events and places within the child's life, represent an excellent alternative to grid displays. While some theories supporting VSD use are supported by research evidence, others are not; however this is not surprising considering the relatively new nature of this area. In their review of the current literature, the authors exclude Jackson et al.'s (2011) study of VSD and grid displays, which found only inconclusive evidence. Considering the small number of studies available on this subject, this exclusion is significant oversight, as it would have provided a more balanced view of the current research. As a result, while the theoretical backing of VSDs provided by the authors for use with children under the age of 4 is compelling, the research supporting these ideas is not available. While the authors are published researchers in this area who are clearly passionate in their support of the use of VSDs, their expert review does not contain all the studies on the topic and their evidence is not conclusive.

Wilkinson, Light, and Drager's (2012) forum note draws on current scientific knowledge of visual and cognitive processing to support the use of VSDs over other display layouts, including grid designs. Drager et al.'s 2003 study on 2 ½ year olds is referenced as well as a presentation by Drager and Light (2010) on current research on children with CCN in which all of the children demonstrated increased social interaction and turn taking when using VSDs composed of photos of familiar events. They cite multiple papers on topics such as visual processing, which support the theoretical basis of VSDs, all of which continue to use solely typically developing children, which as previously discussed, is problematic. The authors also cite what appears to be compelling research regarding the ability of infants with CCN to be visually engaged by VSDs containing familiar animate figures. However, no statistical evidence is mentioned, and the manuscript is noted to be in the preparation stage. Therefore, the validity of this evidence cannot be assessed. While the authors are experts and well-researched, their overview of current research studies using VSDs also excludes Jackson et al.'s 2011 study. Ultimately, this forum note provides valuable information regarding how the design of a VSD may facilitate comprehension and visual processing, but studies that show the benefit of VSDs over other types of overlay designs are not consistently conclusive.

Discussion

In general, a survey of the current research regarding the suitability of VSDs and grid displays for early intervention is inconclusive. Only one study included children with complex communication needs, which, considering that this is the target population of intervention, is clearly an area that requires further

investigation. Additionally, of the three published studies on this topic, two are conducted by the same researchers (Drager and Light) using the similar methodology, the flaws of which have already been discussed. Both studies also misleadingly claim statistical significance for VSDs, when in fact, this is not the case. The third study by Wilkinson et al. found statistically significant results in only one domain, in which children performed best in the grid condition, with no statistical results to support VSDs over grids. Similarly, while each of the expert opinion papers and the forum note contain compelling theoretical arguments for the use of VSDs with young children, strong and repeated statistical evidence indicating improved performance of children with CCN when using a VSD instead of a grid display is lacking. Troublingly, the expert papers and forum review are written by many of the same authors, and do not include the study by Jackson et al (2011). Each of these expert reviews also supported the use of VSDs by citing the Drager and Light studies (2003 and 2004) with their erroneous reports of statistical significance, as well as many studies that were not yet published or could otherwise not be accessed by the public. This may indicate a bias towards VSDs by these researchers when the evidence to support their use does not currently exist.

Ultimately, more research is needed in this rapidly-evolving area of speech language pathology, particularly studies involving children with complex communication needs.

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Clinical Implications

When recommending AAC intervention in the preschool population, both visual scene displays and grid displays with the items organized schematically would likely be appropriate. Considering the heterogeneity of the preschool population requiring early AAC intervention, trialing different layouts would be important in determining the child's individual preference, and which design works best for the intended situational use. Additionally, considering the difficulty many children had in learning how to use the AAC devices, intensive training and integration of into everyday activities would likely be crucial to the child's success.

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