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Serial Memory Retrieval of Picture Communication Systems with AAC Selection Techniques: An Investigation of Working Memory Capacity Resources

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Abstract

Purpose: This study investigated the working memory capacity resources of typically developing school age children sequentially retrieving Picture Communication Symbols (PCSs) using direct selection and visual linear scanning with fixed communication displays. Four types of retrieval errors (i.e., non-sequential object errors, non-sequential location errors, sequential object errors, and sequential location errors) were also examined to isolate the task demands of using selection techniques with fixed displays from a working memory capacity model.
Method: Two hundred forty children from first-, third-, and fifth-grades were stratified for gender and randomly assigned to direct selection or visual linear scanning. Participants sequentially retrieved various numbers and arrays of PCSs during a picture span assessment protocol.
Results: Children were able to obtain greater picture spans with direct selection than visual linear scanning. Developmental differences were also obtained between the three grade levels, with older children demonstrating larger picture spans than younger children. Children demonstrated more sequential errors than non-sequential errors and more location errors than object errors.
Conclusions: AAC practitioners should be sensitive to the task demands of sequentially retrieving PCSs with direct selection and visual linear scanning from a working memory capacity model. Theoretical and clinical implications are discussed in relation to allocating and reallocating resources to increase working memory capacity. Basic and applied research is needed with children who demonstrate complex communication needs to better understand the developmental process when using selection techniques with communication displays.

Introduction

There has been considerable interest over the last decade regarding the task demands and cognitive abilities needed when using selection techniques with aided communication systems in augmentative and alternative communication (AAC) (Horn & Jones, 1996; Mizuko & Esser, 1991; Mizuko, Reichle, Ratcliff, & Esser, 1994; Petersen, Reichle, & Johnston, 2000; Ratcliff, 1987, 1994; Wagner & Jackson, 2006). The impetus for these studies was that researchers could

delineate the cognitive, linguistic, and motor demands that are imposed by various components of communication systems. AAC practitioners could then consider these demands when planning treatment programs to promote communicative competency for people with complex communication needs. Previous investigations in AAC have provided a better understanding of the task demands and cognitive abilities needed when using selection techniques (Horn & Jones, 1996; Mizuko & Esser, 1991; Mizuko, et al., 1994; Petersen, et al., 2000; Ratcliff, 1987, 1994). However, these investigations have not used a developmental working memory capacity model through picture span when investigating selection techniques with communication displays. Such a model could provide a unique framework that isolates the task demands of selection techniques through the availability of working memory resources. AAC researchers could eventually consider the availability of these resources in the consortium of other demands placed on people who use selection techniques during the communicative process. Also, when the cognitive demands of using selection techniques during the communicative process exceed the availability of working memory resources, researchers could investigate ways to increase the efficiency of storing and processing information in working memory.

Purpose

The purpose of this study was to investigate the developmental working memory capacity resources of first-, third-, and fifth-grade students by comparing their serial memory retrieval abilities of common noun PCSs using direct selection and visual linear scanning with fixed communication displays. This study will extend Wagner and Jackson's (2006) previous work by investigating the serial retrieval abilities of older school age children and using larger fixed communication displays. Also, four specific types of retrieval errors (i.e., non-sequential object errors [NSOEs), non-sequential location errors [NSLEs], sequential object errors [SOEs], and sequential location errors [SLEs]) will be examined. These retrieval errors will be examined in perspective to a working memory capacity model.

Methods

This study used an experimental design with between-group comparisons. Participants were blind to their assigned group and stratified for gender. Eighty boys and 80 girls from each grade level were randomly assigned to one of the two experimental conditions--selection techniques using direct selection or visual linear scanning with fixed communication displays. This design tested the effects of the following: (a) grade and selection techniques on the retrieval of PCSs; and (b) grade and selection techniques on the type of retrieval errors

Results

Mean Errors Broken Down by Grade, Selection Technique, Sequence, and Type

Grade in School	Selection Technique	Sequence	Error Type	Errors		
				Mean	Std Dev	n
1st	Direct	Non-Sequential	Object	.18	.796	40
			Location	2.58	2.217	

		Sequential	Object	4.05	3.436	
			Location	3.03	3.108	
	Linear	Non-Sequential	Object	.35	.796	40
			Location	3.25	2.217	
		Sequential	Object	2.98	3.436	
			Location	2.35	3.108	
3rd	Direct	Non-Sequential	Object	.38	.796	40
			Location	3.28	2.217	
		Sequential	Object	4.45	3.436	
			Location	3.68	3.108	
	Linear	Non-Sequential	Object	.45	.796	40
			Location	3.85	2.217	
		Sequential	Object	3.50	3.436	
			Location	3.20	3.108	
5th	Direct	Non-Sequential	Object	.50	.796	40
			Location	3.65	2.217	
		Sequential	Object	5.53	3.436	
			Location	4.75	3.108	
	Linear	Non-Sequential	Object	.28	.796	40
			Location	3.33	2.217	
		Sequential	Object	3.00	3.436	
			Location	2.48	3.108	

Conclusions

Direct selection and visual linear scanning with fixed communication displays were examined with typically developing school age children from a working memory capacity model. Results revealed that children's capacity resources were impacted by selection techniques, developmental age, and the inherent complexity of retrieving PCSs with fixed displays. Although the results cannot be generalized to children with complex communication needs, theoretical and clinical implications of these data will be discussed in perspective to memory allocation and reallocation of resources. Future research is needed with children who demonstrate complex communication needs to better understand their developmental memory capacity resources when using selection techniques and communication displays.