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How do verbal short-term memory and working memory relate to the acquisition of vocabulary and grammar? A comparison between first and second language learners



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ABSTRACT

Previous studies show that verbal short-term memory (VSTM) is related to vocabulary learning, whereas verbal working memory (VWM) is related to grammar learning in children learning a second language (L2) in the classroom. In this study, we investigated whether the same relationships apply to children learning an L2 in a naturalistic setting and to monolingual children. We also investigated whether relationships with verbal memory differ depending on the type of grammar skill investigated (i.e., morphology vs. syntax). Participants were 63 Turkish children who learned Dutch as an L2 and 45 Dutch monolingual children (mean age = 5 years). Children completed a series of VSTM and VWM tasks, a Dutch vocabulary task, and a Dutch grammar task. A confirmatory factor analysis showed that VSTM and VWM represented two separate latent factors in both groups. Structural equation modeling showed that VSTM, treated as a latent factor, significantly predicted vocabulary and grammar. VWM, treated as a latent factor, predicted only grammar. Both memory factors were significantly related to the acquisition of morphology and syntax. There were no differences between the two groups. These results show that (a) VSTM and VWM are differentially associated with language learning and (b) the same memory mechanisms are employed for learning vocabulary and grammar in L1 children and in L2 children who learn their L2 naturalistically.

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Introduction

There is increasing evidence that verbal working memory is related to the acquisition of vocabulary and grammar in both first language (L1) and second language (L2) learning (Adams & Gathercole, 1996, 2000; Baddeley, Gathercole, & Papagno, 1998; French & O'Brien, 2008; Masoura & Gathercole, 2005). Significant correlations with language learning have been found for both components of verbal memory, that is, for verbal short-term memory (VSTM), or the capacity to store verbal information, and for verbal working memory (VWM), or the ability to process verbal information while it is being stored. However, few studies have simultaneously examined effects of VSTM and VWM on language learning in the same sample. In addition, to the best of our knowledge, no previous studies have investigated (a) whether relationships between VSTM or VWM and language learning are the same for L1 and L2 children and (b) whether these relations are similar for vocabulary and grammar.

VSTM has been considered important for the development of stable phonological representations in long-term memory that are needed for vocabulary and grammar learning based on studies with L1 or L2 children (Baddeley et al., 1998; Speidel, 1989). VWM has been considered important for grammar learning through its involvement in noticing (Mackey, Philp, Egi, Fuji, & Tatsumi, 2002) and processing of linguistic structures (Harrington & Sawyer, 1992; Sunderman & Kroll, 2009), but these claims have been almost exclusively based on L2 classroom studies. There is some evidence, however, that VWM is related to grammar learning more strongly in explicit L2 learning conditions than in implicit learning conditions (Tagarelli, Borges Mota, & Rebuschat, 2011), in line with the idea that explicit learning requires the control of attention, an important function of VWM.

In this study, we aimed to obtain a more complete picture of how verbal memory relates to language learning than in previous studies by investigating how the two components of verbal memory (VSTM and VWM) relate to two domains of language (vocabulary and grammar) in two learner groups (L1 children and naturalistic L2 children). In so doing, our goals were to obtain a better understanding of a potentially major source of individual differences in L1 and L2 vocabulary and grammar learning and to shed more light on whether the same verbal memory processes are involved in L1 and naturalistic L2 learning.

To the best of our knowledge, only two previous studies have simultaneously looked at effects of VSTM and VWM in the same sample, but both looked at L2 children acquiring their L2 in the classroom (Engel de Abreu & Gathercole, 2012; Kormos & Sáfár, 2008). For these children, a division of labor between the two memory components was found; whereas VSTM was associated with L2 vocabulary, VWM was associated with L2 grammar. In this study, we investigated whether the same relationships apply to children acquiring their L2 naturalistically, without formal instruction, and children acquiring their native language.

Verbal working memory and language learning

A common view on the structure of working memory holds that working memory is not a single store but rather a system containing separate but interacting components (Baddeley & Hitch, 1974). Besides a domain-general component termed central executive, there are two domain-specific storage components for verbal and visuospatial information. The verbal storage component, or “phonological loop,” allows the storage of verbal information for short periods of time; the visuospatial sketchpad enables the storage of visual and spatial representations. The central executive is a domain-general component responsible for a range of processes such as controlling and monitoring information, retrieving information from long-term memory, and attentional control (Baddeley & Logie, 1999). Studies on young children using confirmatory factor analyses have shown that all working memory components are in place from 4 years of age onward (Alloway, Gathercole, Willis, & Adams, 2004).

VSTM has typically been measured through simple span tasks that require the storage of verbal units such as nonwords and digits. VWM has been measured through complex span tasks that require the simultaneous short-term storage and processing of information. For example, in sentence span tasks, participants are asked to recall the last word of each sentence in a series of sentences while

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