



## The advantage of reading over listening text comprehension in Down syndrome: What is the role of verbal memory?

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### ABSTRACT

The current study was designed to investigate the role played by verbal memory in the advantage shown by individuals with Down syndrome in reading over listening text comprehension (Roch & Levorato, 2009). Two different aspects of verbal memory were analyzed: processing load and coding modality. Participants were 20 individuals with Down syndrome, aged between 11 and 26 years who were matched for reading comprehension with a group of 20 typically developing children aged between 6;3 and 7;3 years. The two groups were presented with a listening comprehension test and four verbal memory tasks in which the degree of processing load and the coding modality were manipulated. The results of the study confirmed the advantage of reading over listening comprehension for individuals with Down syndrome. Furthermore, it emerged that different aspects of verbal memory were related respectively to reading and to listening comprehension: visual memory with low processing load was related to the former and oral memory with high processing load to the latter. Finally, it was demonstrated that verbal memory contributed to explain the advantage of reading over listening comprehension in Down syndrome. The results are discussed in light of their theoretical relevance and practical implications.

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### 1. Introduction

One of the areas investigated in the study of text comprehension in individuals with Down syndrome regards the differences in the ability to understand oral and written text (Bodreau, 2002; Byrne, MacDonald, & Buckley, 2002; Laws & Gunn, 2002; Nash & Heath, in press; Roch & Levorato, 2009; Roch, Florit, & Levorato, 2011). In the study of Roch and Levorato (2009), it was shown that individuals with Down syndrome show poorer oral language skills than expected on the basis of their reading comprehension. Twenty-three individuals with Down's syndrome aged between 11 and 18 years were matched for reading comprehension to 23 first-grade typically developing children aged between 6 and 7 years. It emerged that individuals with Down syndrome performed more poorly than typically developing children in listening comprehension. These results suggested that individuals with Down syndrome have an advantage in reading text comprehension over listening text comprehension. This advantage did not stem from their ability to read words and non words: they had good reading skills, which did not provide a statistical contribution to reading comprehension.

One possible factor contributing to the advantage in understanding written over oral texts might be a different allocation of verbal memory resources. The current study was designed to test this hypothesis.

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Verbal memory represents an area of weakness in this population (Jarrold & Baddeley, 1997), mainly when the processing demands of the task are high (Kittler, Krinsky-McHale, & Devenny, 2008). Lanfranchi, Cornoldi, and Vianello (2004) tested a group of individuals with Down syndrome on four verbal memory tasks requiring increasing levels of processing load and found that the higher the level of processing load, the poorer the recall of verbal information was. Similarly, Vicari, Carlesimo, and Caltagirone (1995) presented individuals with Down syndrome with two verbal memory tasks: one consisted in a forward serial recall task and required a low processing load, the other consisted in a backward serial recall task and required a high processing load. Individuals with Down syndrome performed poorly on both tasks, when compared to a control group matched for mental age, but their performance was particularly low when the memory task required a high processing load.

The relationship between verbal memory and reading comprehension has been demonstrated in a recent study (Levorato, Roch, & Florit, 2011) with individuals with Down syndrome and typically developing children matched for reading comprehension: participants were administered both a task with low processing load (forward serial recall task) and a task with high processing load (backward serial recall task). The results showed that, in both groups, verbal memory makes a unique contribution to reading comprehension, over and above the role played by linguistic skills. This contribution regarded primarily the task having a high processing load (14% of variance), but also the task having a low processing load (6% of variance). This was the first study to demonstrate the existence of such a relationship in individuals with Down syndrome, although researchers had already shown it exists in preschool and school-aged typically developing children (Cain, Lemmon, & Oakhill, 2004; Cain, Oakhill, & Bryant, 2004; Florit, Levorato, Roch, & Altoe, 2009; Goff, Pratt, & Ong, 2005; Seigneuric, Ehrlich, Oakhill, & Yuill, 2000; Swanson & Berninger, 1995).

An explanation of the role of verbal memory in text comprehension was proposed by Daneman and Carpenter (1980, 1983). It states that verbal memory, which is responsible for the processing and the maintenance of the linguistic information during text comprehension, has limited resources; therefore, there is a performance trade-off between the demands of the comprehension process and the amount of information that can be stored (see also Daneman & Merikle, 1996). If verbal memory is overloaded by processing demands, limited resources remain available to maintain the information, and then it is difficult to integrate the information expressed in the text and construct the semantic representation (Cain, 2006).

The current study aims to take the research one step forward by analyzing the role that verbal memory plays in determining different performances in listening and reading comprehension. The former might require a greater processing load because the pace of processing is set by the speaker, whereas in the case of written texts, information processing is self-paced. Moreover, in reading comprehension the text remains available, whereas it fades in the case of oral text. Given that individuals with Down syndrome usually show poor performance on tasks having high processing demands (Lanfranchi et al., 2004; Levorato et al., 2011; Vicari et al., 1995), the gap between listening and reading comprehension in this group might be explained by a difference in the degree of processing load required for each of the two. Another aspect of the role of verbal memory in different types of text comprehension concerns the modality, oral and visual: as shown by recent studies individuals with Down syndrome perform better in memory tasks when the information to be remembered is presented visually rather than orally (Brock & Jarrold, 2004, 2005; Jarrold, Baddeley, & Hewes, 2000; Jarrold, Baddeley, & Phillips, 2002; Laws, 1998).

In the current study, we put forward the hypothesis that processing load and coding modality might be responsible for differences in the comprehension of written and oral texts. To our knowledge this is the first study that takes both these variables into account in the analysis of verbal memory skills in Down syndrome.

Considering that verbal memory involves skills that are associated to text comprehension, namely lexical and semantic skills, (see Cain, 2006; Stothard & Hulme, 1992), and following previous studies on verbal memory and text comprehension (Florit et al., 2009; Levorato et al., 2011), receptive vocabulary was controlled for its possible mediating role in the relationship between verbal memory and text comprehension.

Our predictions going into this study can be summarized in four distinct points:

- (1) *Reading and listening text comprehension.* In the current study individuals with Down syndrome were matched to typically developing children for reading comprehension: we predicted group differences in listening text comprehension, with individuals with Down syndrome showing poorer performance than typically developing peers (Roch & Levorato, 2009; Roch et al., 2011). This result would confirm the presence of the gap between listening and reading comprehension in this population.
- (2) *Verbal memory.* Both groups would perform better, in both modalities, on memory tasks requiring a low processing load than they would on memory tasks with a high processing load. However, we expected group differences between individuals with Down syndrome and typically developing children for the two coding modalities, due to a poorer performance of individuals with Down syndrome in oral than in visual coding.
- (3) *Relationship between verbal memory and text comprehension.* We expected that the modality of presentation and the degree of processing load are associated in different ways to listening and reading comprehension.

We expected no group differences with respect to the relationship between verbal memory and text comprehension (listening and reading), in accordance with previous evidence (Levorato et al., 2011).

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