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Online processing of causal relations in beginning first and second language readers

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ABSTRACT

We investigated online processing of causal relations in beginning first (L1) and second language (L2) readers (8–10 years old). By means of eye-tracking, we measured children's processing times of two-clause sentences including a causal relation. Two text-related factors were investigated: coherence marking (i.e., presence vs. absence of the Dutch connective *omdat* 'because') and linear order of clauses (i.e., cause-effect vs. effect-cause). In addition, syntactic knowledge was included as a child-related factor of interest. The results showed that coherence marking and individual differences in syntactic knowledge influenced children's online sentence processing. In contrast to L1 readers, the absence of a connective led to longer sentence processing times for L2 readers with lower syntactic knowledge; they experienced more difficulty with processing sentences in which no connective was present. Apparently, L2 readers with limited syntactic knowledge benefit from coherence marking provided by a connective, which allows them to establish the causal coherence relation between clauses in a more efficient way. Reversing the linear order of clauses did not affect children's online sentence processing. This study provides an initial step towards the use of online measures to examine sentence processing in beginning L1 and L2 readers aimed at gaining more insight into L2 reading comprehension difficulties.

1. Introduction

1.1. Background to the study

Being able to comprehend written text is a highly important skill. However, children who are confronted with the challenging task of learning to read in their second language, such as children from language minorities for whom the language of instruction at school differs from their home language, often experience reading comprehension difficulties (Droop & Verhoeven, 2003; Lesaux, Lipka, & Siegel, 2006; Mancilla-Martinez & Lesaux, 2010). These children can be referred to as second language readers (L2 readers), since they acquire their second language mainly from their school environment and usually this is the only language in which they learn to read at school. Previous studies have shown that L2 readers' reading comprehension difficulties are probably not a consequence of poor decoding skills; their decoding skills are found to be in the average range (Geva & Zadeh, 2006; Mancilla-Martinez & Lesaux, 2010) and develop at a more or less equal rate compared to L1 readers (Lesaux & Siegel, 2003; Verhoeven, 2000). By contrast, there is a large discrepancy in the linguistic proficiency of L1 and L2 readers, for instance in terms of their vocabulary and syntactic knowledge in the target language (Melby-Lervåg & Lervåg, 2014). Previous research has shown that oral language skills are important for reading comprehension performance and development, even more so for L2 readers (Droop & Verhoeven, 2003; Lervåg & Aukrust, 2010). L2 readers' reading comprehension difficulties can already be observed early in the process of learning to read (Verhoeven, 2000). In these early stages, beginning readers move from reading isolated words to reading sentences and short texts in which they have to integrate word meanings in the context of a sentence or a text, also referred to as word-to-text integration (WTI; Perfetti, Yang, & Schmalhofer, 2008). For WTI processes to take place, both text and reader characteristics play an important role.

There are textual factors that can help the reader to construct a coherent mental representation of a text. One textual factor in that respect is the use of linguistic markers, such as connectives. Connectives (i.e., conjunctions such as *because*, *therefore*) are cohesive devices that signal the relation between clauses; they are critical to the construction of a coherent text representation (Cain & Nash, 2011). Connectives can be classified according to the type of relationship they signal (i.e., additive, adversative, causal, and temporal), as put forward by Halliday and Hasan (1977) based on their extensive analysis of connective devices. Connectives can guide the reader in how to construct meaning by coding coherence relations, for instance when processing sentences

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with causal relations (Canestrelli, Mak, & Sanders, 2013; Sanders & Noordman, 2000). In particular, less-skilled adolescent readers appear to benefit from the presence of (causal) connectives (Land, 2009; Van Silfhout, Evers-Vermeul, Mak, & Sanders, 2014). Furthermore, Cain and Nash (2011) showed that connectives even support online text processing in 8- and 10-year-old less-experienced monolingual readers whose knowledge and comprehension of connectives are still developing. However, the question is whether linguistic markers, such as connectives, also support L2 readers with limited proficiency in their second language. On the one hand, based on studies showing that less-skilled readers particularly benefit from linguistic markers in the text, one could argue that this would also hold for L2 readers with poor reading comprehension performance. Connectives may help these readers to identify text structure and to establish a coherent mental model (Degand & Sanders, 2002). On the other hand, one may predict that because of their limited linguistic proficiency in the target language, L2 readers are not competent enough to benefit from the coherence marking provided by connectives. That is to say, connectives are relatively infrequent in texts and may pose extra challenges in terms of both vocabulary knowledge and the type of inter-clausal relationship they signal (Crosson, Lesaux, & Martiniello, 2008). In a study with L2 readers of English, Crosson and Lesaux (2013) showed that bilingual fifth-graders lagged behind their monolingual peers in knowledge of several types of connectives, and that the influence of connectives on reading comprehension varied by readers' linguistic background (i.e., L1 vs. L2). An explanation put forward in line with the findings of Degand and Sanders (2002) is that L2 readers need to be proficient enough in their second language in order to benefit from the coherence marking provided by connectives.

Another relevant textual factor with respect to processing causal relations is word order, or more specifically, linear order. To illustrate, the two following sentences differ in linear order: 1) *Because Tom worked hard, he passed the exam*, 2) *Tom passed the exam, because he worked hard*. The first sentence has an iconic order (i.e., cause-effect), whereas the second sentence has a non-iconic order (i.e., effect-cause). Previous studies have shown contrasting findings with respect to the effect of linear order on online processing. On the one hand, it is assumed that an iconic order facilitates processing: if the order of clauses corresponds to the order of causality in the world, it is easier to understand the sentence (Noordman & De Blijzer, 2000). This is confirmed by a study of Noordman and Vonk (1998), who used several experimental texts containing a causal relation expressed in two different orders. On the other hand, there are also studies showing that non-iconic sentences are easier to process, rather than iconic sentences (e.g., Graesser, Singer, & Trabasso, 1994; Magliano, Baggett, Johnson, & Graesser, 1993). These studies suggest that readers are more likely to make knowledge-based inferences about causal antecedents (i.e., *Tom passed the exam, so he must have worked hard*), than about effects or consequences (i.e., *Tom worked hard, so he must have passed the exam*). One explanation put forward for these incongruent findings relates to the differences in predictability of the causal relations that are investigated (Noordman & Vonk, 1998), which can be either a consequence of the specific relations expressed in the sentence (some relations are more predictable than others; Mak & Sanders, 2013) or the cognitive/linguistic capacities of the reader (some readers make better predictions than others; Martin et al., 2013). With respect to the latter, it should be noted that in previous studies university students were involved for whom the predictability of causal relations is relatively high in general. It might well be the case that for beginning readers, and especially beginning L2 readers with limited linguistic proficiency in the target language, a beneficial effect of non-iconic sentences over iconic sentences only prevails when the causal relation is highly predictable in itself. Another explanation lies in the amount of word order flexibility languages permit (Kaiser & Trueswell, 2004). In the case of L2 readers, it has indeed been demonstrated that facilitating effects may occur if the language structure or syntax of their second language is congruous with their first language (Bialystok, Luk, & Kwan, 2005; Durgunoglu, 2002; Nagy, Mcclure, & Mir, 1997).

Apart from the text, characteristics of the reader play a crucial role in online text processing. Children's syntactic knowledge is often mentioned as an important predictor for reading comprehension performance (e.g., Oakhill, Cain, & Bryant, 2003). Moreover, the meta-analysis of Jeon and Yamashita (2014) showed that for L2 reading comprehension, L2 syntactic knowledge was the strongest correlate. That is to say, the reader needs to have accurate syntactic knowledge for understanding the syntactic structure of a sentence. These parsing processes are required for comprehension (Perfetti & Stafura, 2014). Of particular relevance is the case of L2 readers, since their L2 oral language skills, including syntactic knowledge, are shown to stay behind compared to L1 readers (Droop & Verhoeven, 2003; Lesaux et al., 2006), which may in turn influence their online sentence processing.

In order to gain more insight into children's WTI processes at the sentence level, online measures can be recommended that expose reading comprehension while it happens (Perfetti & Stafura, 2014). Previous studies using event-related potentials (ERPs) as an online measure to examine the integration processes in adult readers revealed processing differences between L1 and L2 readers (Kaan, Kirkham, & Wijnen, 2016; Martin et al., 2013). However, there are hardly any studies in which online measures have been used to compare online sentence processing in young L1 and L2 readers. Although eye-tracking is used more often in recent research on children's language and literacy skills (Blythe & Joseph, 2011), its use is limited to older, more experienced readers in upper primary school (e.g., De Leeuw, Segers, & Verhoeven, 2016; Van der Schoot, Vasbinder, Horsley, & Van Lieshout, 2008) and secondary education (Van Silfhout et al., 2014). The few studies on online sentence processing that focused on beginning readers (8–10 years old) were also restricted to monolingual children and focused on age differences rather than variation in linguistic proficiency (Cain & Nash, 2011; Wannacott, Joseph, Adelman, & Nation, 2015). In order to provide more insight into L2 readers' comprehension problems, it is essential to investigate the effect of textual and child-related factors on online sentence processing in beginning L1 and L2 readers.

1.2. The present study

In the present study, we used an online sentence reading task including two-clause Dutch sentences with a causal relation (e.g., *Because Tom was hungry, he ate an apple*) in order to investigate two textual factors related to syntactic structure (i.e., coherence marking and linear order of clauses) in two groups of beginning readers: Dutch monolingual children with Dutch as their first language (L1 readers) and Turkish-Dutch bilingual children with Dutch as their second language (L2 readers). In addition to children's language background (i.e., L1 vs. L2), we investigated the role of individual differences in syntactic knowledge as a child-related factor of interest for online sentence processing. Eye-tracking was used to measure children's sentence processing times. Taking a closer look at the native Turkish-speaking children as L2 readers of Dutch, two points should be noted. First, they were expected to have lower L2 syntactic knowledge than the L1 readers (cf. Droop & Verhoeven, 2003; Lipka & Siegel, 2007), which may in turn influence the extent to which they make use of connectives during processing and comprehending sentences. Second, their first language (i.e., Turkish) has a more flexible word order (Nilsson, 1991), which may influence the extent to which alternating word order (or linear order of clauses) affects their online text processing and comprehension in L2.

The following research question was central to the present study: To what extent are beginning L1 and L2 readers' online processing times of sentences with causal relations influenced by (a) coherence marking, (b) linear order of clauses, and (c) individual differences in syntactic knowledge? For coherence marking, we expected that beginning readers would benefit from the presence of connectives, and that L2