



Analogical mapping across modalities in children with specific language impairment (SLI)



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ABSTRACT

Analogical mapping is a domain-general cognitive process found in language development, and more particularly in the abstraction of construction schemas. Analogical mapping is considered as the general cognitive process which consists in the alignment of two or several sequences in order to detect their common relational structure and generalize it to new items. The current study investigated analogical mapping across modalities in children with specific language impairment (SLI). Nineteen children with SLI and their age-matched peers were administered two tasks: a linguistic analogical reasoning task (composed of syllables) and a similar non-linguistic analogical reasoning task (composed of pictures). In the two tasks, the items presented were divided into two groups: items with perceptual cues and items without perceptual cues. Children had to complete a sequence sharing the same relational structure as previously presented sequences. Results showed an expected group effect with poorer performance for children with SLI compared to children with typical language development (TLD). Results corroborate hypotheses suggesting that children with SLI have difficulties with analogical mapping, which may hinder the abstraction of construction schemas. Interestingly, whereas no interaction effect between group and modality (linguistic vs. non-linguistic) was revealed, a triple interaction Group * Modality * Perceptual support was observed. In the non-linguistic task, the performance of children with SLI was the same for items with and without perceptual clues, but in the linguistic task they performed more poorly for items without perceptual cues compared to items with perceptual cues. The results and limits of the study are discussed.

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1. Introduction

The cognitive grammar approach to language acquisition proposes that grammar development is conceptualization (Langacker, 1987). Children develop their linguistic system by a gradual process of generalization from lexicalized forms (detected in linguistic input) to abstract forms (or construction schemas) (Bybee, 2010; Goldberg, 2006; Tomasello, 2003). According to Goldberg (1995, 2006) and Tomasello (2000, 2003), pattern-finding is the central cognitive construct in grammar acquisition. It allows children to go beyond linguistic input and create abstract linguistic schemas. This pattern-finding involves several general cognitive processes; one of them is *analogical reasoning*. Tomasello (2003) proposes that

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children make analogies across whole utterances to reach the more abstract dimension of linguistic competence. According to Gentner and Markman (1997), analogical reasoning makes it possible to generalize known forms to new linguistic contexts. Analogy is considered as a domain-general process which underlies the abstraction of linguistic forms and the construction of the linguistic system. The importance of analogy makes it likely that disordered analogical reasoning will have severe consequences on the abstraction of construction schemas, entailing poor productivity and creativity with language and a greater dependency on linguistic input.

Children with specific language impairment (SLI) present a linguistic developmental pathology characterized by the slow development of spoken language. Their language difficulties cannot be explained by hearing loss, late motor development or global cognitive disorders (Leonard, 1998; Schwartz, 2009). Furthermore, children with SLI do not present with other neurodevelopmental disorders such as autism nor do they suffer from intellectual and emotional impairments (Leonard, 1998; Schwartz, 2009). Although children with SLI present varied language profiles, a common profile in children with SLI is a mild to severe deficit in at least two language areas and a generally greater weakness in the morphosyntactic component (Schwartz, 2009). Several authors have observed that the difficulties of children with SLI are characterized by a lack of syntactic productivity and a greater input dependency. These observations are in agreement with the hypothesis of an impaired ability to generalize language forms. As argued by Riches, Faragher, and Conti-Ramsden (2006): “(...) these children resemble children at a younger language stage in terms of their syntactic creativity and their tendency to use rote-learned forms”. We speculate that this lack of generalization may be underlain by a deficit in analogical reasoning, and more particularly by a deficit in analogical mapping.

In this paper, we hypothesize that analogical reasoning, and more particularly the process of mapping, is problematic in children with SLI. We inquire whether children with SLI are able to detect a relational similarity between several elements within sequences and to transfer this learning to a novel sequence of elements. Further, we surmise that children with SLI will have greater difficulty detecting relational similarities in verbal sequences (which involve linguistic processing) than in nonverbal sequences (which involve visual processing). If children with SLI have difficulties finding the similar relational structure between two situations and using it with other elements, this could explain their lack of syntactic creativity and it could thus explain the lack of generalization of construction schemas and a greater dependency on linguistic input.

2. Analogical reasoning in children with SLI

Until now, most of the studies that have addressed analogical reasoning in children with SLI sought to explore the influence of cognitive and linguistic abilities on analogical reasoning tasks (Masterson, Evans, & Aloia, 1993; Nippold, Erskine, & Freed, 1988). Analogical reasoning was assessed by using the “A:B::C:D” paradigm. Children had to deduce the relation between the first two items (A:B) and then transfer this relation to another pair of items (C:D). The items used were utterances or words as well as geometric shapes. Nippold et al. (1988) investigated analogical mapping in 20 children with SLI, aged 6–8 years, compared to mental-age matched children with typical language development (TLD). In the first task, children heard utterances and had to compare them in order to produce a new fourth form (e.g., *Warm (A) goes with cold (B) just as happy (C) goes with...? (D)* – *Response: unhappy*). In the second task, the instructions were the same but the items used were geometric shapes. Results indicated that children with SLI performed more poorly than children with TLD on both tasks. However the group effect disappeared when the data were reanalyzed by controlling for nonverbal intelligence score, suggesting that nonverbal abilities underlie these analogical reasoning tasks. Masterson et al. (1993) investigated the influence of cognitive and linguistic abilities on the performance of children with SLI using five types of verbal analogical reasoning tasks: synonyms (e.g., *easy:simple::shut:?*); antonyms (e.g., *cool:warm::black:?*); linear order (e.g., *puppy:dog::cub:?*); category membership (e.g., *red:color::hit:?*); and functional relationship (e.g., *horn:play::horse:?*). The performance of children with SLI was compared to the performance of two groups of normally developing children: a group of mental-age matched peers – matched on nonverbal intelligence – and a group of language-age matched peers – matched on their lexical production score. Children with SLI performed more poorly than their mental-age matched peers on all of these tasks. Moreover, although children with SLI had a higher mental age than their language-age matched peers, this difference did not help children with SLI, who always performed less well than their language-age matched peers (except for antonyms). Consequently, when nonverbal abilities are controlled, the results obtained in the two studies are contradictory.

As mentioned by Masterson and Perrey (1999, p. 5) “These studies indicate that knowledge of vocabulary, sufficient exposure to the type of relationship used in an analogy and the ability to see the similarity between analogy components are three potential problems for the solution of analogies by children with language disorders”. In these tasks, the resolution of problems requires not only more general cognitive processes (such as working memory or inhibitory control), but also linguistic knowledge. The semantic component plays a fundamental role because different kinds of semantically-based implicational relationships are involved. Moreover, these tasks required considerable metalinguistic thought. Consequently, the performance of children with SLI in these verbal reasoning tasks may not specifically reflect a problem with the processes required in analogical reasoning, but could be the consequence of poor linguistic knowledge. In this paper, we study the influence of analogical mapping, which is the core process of analogical reasoning, on the language development of children with SLI. Analogical mapping plays a fundamental role in language development. Although the literatures on schemas and analogy were previously largely independent, recent theoretical considerations have envisaged the implication of analogical mapping in the abstraction of construction schemas.

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