



# Thinking maps enhance metaphoric competence in children with autism and learning disabilities

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## ABSTRACT

The primary goal of the current study was to examine the ability of children with autism (ASD) and children with learning disabilities (LD) to improve their metaphoric competence by an intervention program using “thinking maps”. Twenty ASD children, 20 LD, and 20 typically developed (TD) children were tested on metaphors and idioms comprehension tests, homophone meaning generation test, and fluency tests. Both ASD and LD groups performed poorly compared with TD on all tests, with the LD group outperformed the ASD group in the executive function tests. The results indicate that the LD group was able to use the “thinking maps” to understand metaphors that were encountered for the first time more efficiently than the ASD group. Furthermore, in the autistic group the homophone meaning generation test, associated with mental flexibility mechanism, correlated with novel metaphors understanding, which do not rely on prior knowledge. In the learning disabilities group, conventional metaphors understanding correlated with the homophone meaning generation test.

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## 1. Introduction

Pragmatic aspects of language are important modes of human communication. In everyday communication some verbal messages convey meanings that go beyond the straightforward word-by-word analysis of the message (i.e., the literal meaning). Thus, sometimes, an accurate grasp of meaning requires interpreting the intention of the speaker and the ability to distinguish between “what is said and what is meant” (Levorato & Cacciari, 2002). This is the case with figurative language that introduces intentional ambiguity to convey messages the meaning of which differs from their literal meaning. A deficit in the processing of non-literal language may result in a fail to use or comprehend this language, which is remarkably frequent in everyday discourse (Gibbs, 1994). Difficulty understanding nonliteral language devices, such as metaphors and idioms has been observed in individuals with learning disabilities (LD) (e.g., Friemuth Lee & Kamhi, 1990) and autism (ASD) (e.g., Happé, 1993, 1995). The aim of the current study is to examine the ability to disambiguate meanings of several figurative forms (e.g., metaphor, idiom, homophones) in these two special population, ASD and LD children, and to test the effects of an intervention program that uses thinking maps in order to enhance metaphor comprehension.

A metaphor is a prototypical form of non-literal language that forms linkages between two seemingly unrelated domains of knowledge. Some theorists suggest that the manner in which a metaphor is comprehended depends on its level of conventionality (e.g., Bowdle & Gentner, 1999, 2005; Giora, 1997; Glucksberg & Keysar, 1990). According to the Career of Metaphor model (Bowdle & Gentner, 2005), novel metaphors are comprehended via a comparison process (i.e., simple matching) in which the semantic features of both concepts (the base term and the target term) are extracted and then are

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matched with one another (Bowdle & Gentner, 2005). The common attributes as well as those that are not in common are then used to establish the ground for the comparison. Conventional metaphors, on the other hand, are understood via categorization, in which the target term becomes a member in a super-ordinate abstract metaphoric category, represented by the base term (Glucksberg, 2001; Glucksberg & Keysar, 1990). Since the meanings of familiar metaphors are lexicalized, i.e., stored in the mental lexicon, the process of understanding conventional metaphors relies mainly on meaning retrieval of stored knowledge and thus may exert less cognitive demands. Like metaphors, the meaning of an idiomatic expression cannot be derived compositionally from the interpretation of its parts. According to the lexical representation hypothesis (Swinney & Cutler, 1979), the computation of the literal interpretation of the expression runs in parallel with the idiomatic expression. Thus, the comprehension of both metaphors and idioms involves pragmatic abilities and higher cognitive functioning that may impose considerable interpretive demands, especially for schoolchildren in the special education, since different interpretations may be available.

Individuals with autism sometimes interpret figurative language literally (Rapin & Dunn, 2003) and hence encounter difficulty in understanding various aspects of figurative language such as idiom (Kerbel & Grunwell, 1998), humor (Ozonoff & Miller, 1996), metaphor, and irony (Happé, 1993, 1995). Children with learning disabilities also tend to interpret figurative expressions literally and fail to combine two distant concepts into a novel metaphoric meaning (e.g., Friemuth Lee & Kamhi, 1990; Nippold & Fey, 1983). This evidence suggests that pragmatic impairment is highly pervasive in individuals with autism and learning disabilities and thus, deserves more attention so that an appropriate intervention can be developed.

One psychological theory that has been tried to explain the high-order language deficits in autism is the executive dysfunction theory (Russell, 1997). The executive dysfunction theory suggests that deficits in executive functions—i.e., the functions responsible for the control of thought and action, such as planning, mental flexibility, inhibition, and shifting set—are the cause of the autism disorder, and not the result of impairments in understanding mental concepts (Pennington & Ozonoff, 1996, for review; Russell, 1997). The behavior deficits addressed by the executive function approach are rigidity and perseveration, manifested by a paucity of new non-routine action initiations and the tendency to persist using one strategy (Hill, 2004). However, evidence for executive dysfunction in ASD is equivocal probably due to the different tasks applied and the nature of the autism and/or control (Spek, Schatorje, Scholte, & Berckelaer-Onnes, 2009). The few studies which examined executive functions in children with LD indicate a relationship between inferior executive functions and a deficiency in reading and comprehension of written and spoken language (Cutting, Materek, Cole, Levine, & Mahone, 2009; Whitney, Mahone, Levine, Eason, & Cutting, 2009).

Executive functions may play an important role in metaphor comprehension since figurative language comprehension engages higher order cognitive functions such as mental flexibility (i.e., select the common attributes of the vehicle and the target term; switch between the literal and the metaphoric meanings) and inhibition control (suppression of the irrelevant literal interpretation). One of the aims of the study was therefore to examine whether metaphoric competence in children with ASD and LD is related to some aspects of executive dysfunctions.

Tests tapping executive function abilities include word fluency tests, where an individual has to produce as many words as possible in one minute. Two common types of fluency tests are in use: phonemic fluency and semantic (category) fluency. Performance on word generation is most strongly correlated with measures of vocabulary, auditory attention, strategic search, and mental flexibility (Kavé, 2005). On a category fluency task, individuals with autism (age 15–40) have been shown to be impaired in relation to non-autistic, age, and ability matched controls (Minsheu, Goldstein, Muenz, & Payton, 1992) as well as on letter fluency tasks (Rumsey & Hamburger, 1988). In other studies, individuals with autism did not differ from controls (Boucher, 1988; Hill & Bird, 2006). In Boucher's study (1988), children with autism (mean age 14.2) were asked to generate words belonging to a specific category (e.g., colors, animals) and were found unimpaired as compared with both learning-disabled and age-matched control groups. Thus, most of the findings regarding the performance of individuals with autism on fluency tasks show an overall impairment, consistent with a deficient mental flexibility. However, studies linking fluency tasks and figurative language comprehension in ASD and LD children are remarkably scarce.

### 1.1. The intervention program

In the current study, we examined the possibility of developing a strategic tool that improves the communication deficits associated with metaphoric language comprehension in ASD and LD children. The development of the intervention tool was motivated by previous pilot results showing that patients who displayed characteristics associated with right-hemisphere damage improved their metaphoric comprehension (Lundgren, Brownell, Soma, & Cayer-Meade, 2006). The intervention program was based on a simple visual mode of representing semantic relations between words using thinking maps. Thinking maps are visual-verbal learning tools that provide graphic representations of the features shared by both words that comprise the metaphoric expression (e.g., *train of thought*), thus providing an explicit basis for metaphor understanding. For example, each of the two concepts “train” and “thought” evokes several associations, as illustrated in Fig. 1. Participants were instructed to generate a broad range of associations for each concept and then to identify the appropriate shared associations that give rise to the shared properties, which in turn evoke the correct interpretation (e.g., a series of connected thoughts). The generation of multiple associations enhances flexible thinking and requires switching from one semantic feature to another until the correct interpretation is achieved.

The objectives of the present study are three-fold: (1) to examine whether children with autism have a similar figurative language profile to children with learning disabilities. (2) To test the efficiency of using thinking maps as a strategic tool to

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