Enhancing the comprehension of visual metaphors in individuals with intellectual disability with or without down syndrome

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ABSTRACT

This study is the first to investigate the effectiveness of deep and shallow intervention programs in the acquisition of visual metaphor comprehension in individuals with non-specific intellectual disability (NSID; aged 15–59, N = 53) or Down syndrome (DS; aged 15–52, N = 50). The deep intervention program was based on dynamic assessment model for enhancing analogical thinking. The shallow intervention program involves memorizing a metaphorical relationship between pairs of pictures. Visual metaphor comprehension was measured by the construction of a metaphorical connection between pairs of pictures. The results indicated that both etiology groups exhibited poor understanding of visual metaphors before the intervention. A significant improvement was observed in both interventions and both etiology groups, with greater improvement among individuals who underwent the deep processing. Moreover, the latter procedure led to greater generalization ability. The results also indicated that vocabulary contributed significantly to understanding unstudied metaphors and that participants with poorer linguistic abilities exhibited greater improvement in their metaphorical thinking. Thus, individuals with ID with or without DS are able to recruit the higher-order cognitive abilities required for visual metaphor comprehension.

What this paper adds?

(a) The current study is the first to investigate the effectiveness of intervention programs in the acquisition of the higher-order cognitive ability of visual metaphor comprehension in individuals with NSID or DS.
(b) The results show for the first time that individuals with ID with or without DS are able to recruit the higher-order cognitive abilities required for deep information processing.
(c) The results show that deep processing is more effective than shallow processing and leads to a greater understanding of visual metaphors, whether or not they had been studied during the intervention.
(d) The results show that participants with poorer linguistic abilities exhibited greater improvement in the comprehension of visual metaphors.

1. Introduction

People often use figurative language in their daily conversation as a means of understanding and conveying information. The
ability to comprehend and produce metaphors reflects the cognitive level of human creativity, abstract reasoning capacity and verbal abilities (Friedmoth & Kamhi, 1990). There is evidence suggesting that metaphor comprehension is impaired in individuals with developmental disorders, including autism-spectrum disorder (ASD) (Baron-Cohen, 1997; Mashal & Kasirer, 2011), learning disabilities (Cain, Oakhill, & Lemmon, 2005; Mashal & Kasirer, 2012) and Williams syndrome (Annaz, Van Herwegen, Thomas, Fishman, Karmiloff-Smith, & Rundblad, 2009; Godbee & Porter, 2013; Van Herwegen, Dimitriou, & Rundblad, 2013). Studies investigating metaphor comprehension in individuals with Down syndrome (DS) are remarkably scarce, except for one case study (Papagno & Vallar, 2001). The current study takes a step forward, being the first to investigate the effect of intervention program on acquiring visual metaphor comprehension among participants with non-specific intellectual disability (NSID) or Down syndrome (DS).

The ability to comprehend visual metaphors is displayed when the participants find a connection between two pictures (e.g., a baby, a rosebud) that are metaphorically related and formulate a sentence that expresses the connection (e.g., A baby is a rosebud). According to Paivio's dual coding theory (Paivio, 1991), pictures have an advantage over words because semantic information is coded via two separate routes. Whereas words are processed only via a verbal route, pictures are processed via both an image pathway and a verbal encoding. Thus, pictorial information increases encoding strength by accessing semantic knowledge via two parallel pathways and is therefore recalled better.

According to some authors metaphor comprehension entails an underlying process of comparison of the metaphor's topic and vehicle based on analogical reasoning (Gentner, 1983). Several studies have shown a link between analogical and metaphorical thinking (Gentner & Bowdle, 2008; Gibbs, 2008). As in analogical processing, a metaphor is first and foremost processed symmetrically from the vehicle to the target and vice versa, and only afterwards from the vehicle to the target alone (Gentner & Bowdle, 2008). Thus, analogical and metaphorical thinking share three cognitive components: similarity between elements, inference from the vehicle to the target through the relationship between them, and identification of the target or the content to which the metaphor or the analogy refers (Holyoak & Thagard, 1989).

1.1. The cognitive profile of individuals with NSID and DS

ID is significantly below average intellectual functioning, including adaptive developmental behavior difficulties (average IQ 70 or less), which are manifested before the age of 18 and lead to impairments in perceptual, social and practical skills. The current study focuses on participants with mild and moderate ID (IQ = 40–70), with NSID or DS. Individuals with NSID have linguistic delays, such as poor language competence (Fink & Cegelka, 1982; Aitchison, 2003), limited vocabulary (Borkowski & Büchel, 1983; Cornoldi, Giofre, Orsini, & Pezzuti, 2014), lack of verbal rehearsal and poor ability to actively retrieve coded information (Hulme & Mackenzie, 1992). They also exhibit difficulties in executive functions, such as working memory (Cornoldi et al., 2014) and in comprehending abstract relations between pairs of objects (Paour, 1992). These deficits in executive functions might pose barriers in acquiring adequate analogical reasoning (Hulme & Mackenzie, 1992).

As in individuals with NSID, the cognitive profile of individuals with DS is characterized by a global cognitive deficit, although some abilities are better preserved than others. Individuals with DS exhibit a remarkable deficit in language abilities compared to their non-linguistic visual-spatial abilities (Gunn & Crombie, 1996). They also exhibit difficulties in executive function skills, particularly working memory, planning (Costanzo et al., 2013; Lanfranchi, Baddeley, Gathercole, & Vianello, 2012) and analogical problem solving (Natsopoulos, Christou, Kiutselini, Raftopoulos, & Karefflidou, 2002). Since metaphor comprehension involves language, executive functions and analogical thinking capacity (Glucksberg, 2008; Gentner & Bowdle, 2008; Holyoak & Thagard, 1989; Mashal & Kasirer, 2011, 2012; Silvia & Beaty, 2012), the cognitive profiles of both etiologies are intriguing, especially with regard to the question of the individuals’ ability to go beyond the concrete level of reasoning and comprehend visual metaphors.

1.2. Metaphor comprehension in individuals with ID with or without down syndrome

The complex nature of figurative language makes it difficult for atypical groups, such as those with ASD (Mackay & Shaw, 2004; Mashal & Kasirer, 2011; Vulchanova, Saldaña, Chabboun, & Vulchanov, 2015), dyslexia (Kasirer & Mashal, 2017) or learning disabilities (Mashal & Kasirer, 2012) to understand. Evidence suggests that children with high-functioning ASD (HFASD) have difficulties in comprehending figurative language and tend to interpret it literally despite spared structural language. Various accounts have been suggested for addressing these difficulties in ASD individuals, including impaired mentalizing skills, semantic ability, central coherence, and executive functions (for a review see Vulchanova et al., 2015). Although it is still unclear what aspects of the profile of autistic individuals can account for their pragmatic deficits, it has been suggested that these impairments are linked to a more general cognitive mechanism dedicated to information processing (Vulchanova et al., 2015).

Only a few studies have tested the comprehension of metaphorical language among individuals with ID. Most of the studies have focused on individuals with Williams syndrome (WS), since they have good language abilities (Jarrold, Baddeley, Hewes, & Phillips, 2001). The results of these studies showed that participants with WS were less able to comprehend metaphorical language than their TD peers matched for chronological age (CA). The WS group experienced difficulties in finding the figurative expressions in stories, avoided answering due to lack of knowledge, and tended to provide literal interpretations (Annaz et al., 2009). Despite the poorer figurative language comprehension in WS than in TD individuals matched for CA, no significant difference was found compared to TD individuals matched for MA (Godbee & Porter, 2013). Papagno and Vallar (2001) tested the ability to comprehend verbal metaphors of a woman with DS (case study, CA = 30, Verbal IQ = 80, Performance IQ = 63). This woman’s general cognitive profile was exceptional compared to other individuals with DS, and she demonstrated good language abilities. However, she had difficulty comprehending verbal metaphors, tending to provide literal interpretations of metaphorical expressions. The study concluded that
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