



Devising Trainings to Enhance the Capabilities of Children With Autism Spectrum Disorder to Cope With Metaphor: A Review of the Literature

Sergio Melogno^{1,2*} and Maria Antonietta Pinto²

¹ Faculty of Psychology, University Niccolò Cusano, Rome, Italy, ² Department of Developmental and Social Psychology, Sapienza University of Rome, Rome, Italy

OPEN ACCESS

Edited by:

Mila Vulchanova,
Norwegian University of Science and
Technology, Norway

Reviewed by:

Likan Zhan,
Beijing Language and Culture
University, China

*Correspondence:

Sergio Melogno
sergio.melogno@uniroma1.it

Specialty section:

This article was submitted to
Language Sciences,
a section of the journal
Frontiers in Communication

Received: 08 April 2022

Accepted: 16 May 2022

Published: 17 June 2022

Citation:

Melogno S and Pinto MA (2022)
Devising Trainings to Enhance the
Capabilities of Children With Autism
Spectrum Disorder to Cope With
Metaphor: A Review of the Literature.
Front. Commun. 7:915873.
doi: 10.3389/fcomm.2022.915873

This article reviews the literature reporting on the trainings implemented with children with Autism Spectrum Disorder (ASD) without intellectual disability to enhance their capability to cope with metaphor comprehension. The studies in this review can be classified into two main strands of thought, behavioral-analytic and psycholinguistic, respectively. Beyond some basic similarities all these studies share in their attempt at training children to consider the semantic features of metaphors, the mental pathways activated by those trainings are based on different cognitive and linguistic processes. The trainings based on the behavioral-analytic perspective teach the meaning of metaphors by making an extensive use of prompts: iconic, echoic, and textual. In the trainings based on the psycholinguistic perspective, instead, a wide range of activities are devised to stimulate children's analytical abilities to cope with semantic relations in metaphors. A significant part of these activities are jointly conducted between adult and children, and aimed at promoting the child's autonomy. Among the most interesting theoretical challenges stemming from the abovementioned studies, this review considers the spontaneous creation of original metaphors in children with ASD when solicited to understand metaphorical expressions. This unexpected reaction highlights the complexity of the relationships between metaphor comprehension and production in children with ASD.

Keywords: children with ASD, metaphor comprehension-production, training, behavioral-analytic perspective, psycholinguistic perspective

INTRODUCTION

What happens in the mind of a child with Autism Spectrum Disorder (ASD) (American Psychiatric Association, 2013) when he/she is faced with metaphorical usages (Gibbs, 1994) is still an object of investigation, from both conceptual and clinical intervention point of view (Happé, 1993, 1995; Dennis et al., 2001; Martin and McDonald, 2004; Norbury, 2005; Gold and Faust, 2010; Rundblad and Annaz, 2010; Gernsbacher and Pripas-Kapit, 2012; Melogno et al., 2012a,b, 2019; Kasirer and Mashal, 2014; Olofson et al., 2014; Chahboun et al., 2017; Van Herwegen and Rundblad, 2018).

From the most recent systematic reviews and meta-analyses (Vulchanova et al., 2015; Kalandadze et al., 2018, 2019, 2022), an interesting outcome apparently emerged that showed the possibility to implement treatments to help this type of child avoid the confusion between literal and metaphorical understanding. It must be noted that the very conception of possible treatments

is recent, which explains that the literature on the implementation of those trainings is limited to a few number of cases, to the best of our knowledge. As pointed out by Lee et al. (2019) the studies in the field can be classified into two major strands of thought: behavioral-analytic and psycholinguistic, respectively.

THE STUDIES

The behavioral-analytic strand is emblematically represented by Persicke et al.'s (2012) study, and more recently, by Lee et al. (2019). The authors' position fundamentally adopt Skinner's (1957) general view about language, defined as "verbal behavior", and metaphor is conceptualized as a type of "extended tact". A tact, in Skinner's terms, is a verbal operant in which a response of given form is evoked by a particular object or event. An extended tact is a reinforced response to a large category of stimuli (e.g., "chair" as referred to many different types of chairs). Metaphor would be a particular case of such an extended tact inasmuch as the properties of a given stimulus "evoke a response and share some, but not all, relevant properties of the stimulus that control the response" (see Lee et al., 2019). For instance, in the famous Shakespearian metaphor "Juliet is the sun" both Juliet and the sun share some common properties, which justifies the extension of the response. However, Persicke et al. (2012), followed by Lee et al. (2019), think that Skinner's position about metaphor does not explain how relevant properties are selected, how the irrelevant ones are excluded, and how relevant properties are related to another stimulus (Stewart and Barnes-Holmes, 2001). Based on those criticisms, Stewart and Barnes-Holmes (2001) elaborated the Relational Frame Theory (RFT) where metaphor is still considered as a behavioral phenomenon but, as in all human and cognition phenomena, it develops "via arbitrarily applicable relations responding" (Hayes et al., 2001). According to RFT, understanding a metaphor intrinsically requires to detect three types of relations: (a) describing the properties belonging to each of its constitutive terms (the authors call "hierarchical relations"); (b) discriminate similarities and dissimilarities of these properties between the two terms ("distinction relations"); (c) form an equivalent relation by selecting the shared properties ("coordination relation"). Persicke et al. (2012), and later on, Lee et al. (2019), whose study we will describe below, adopted RFT as a basis to implement their program especially targeted for children with ASD, who were taught the meaning of nominal metaphors (of the "X is Y" type; e.g., "He is a super hero", referred to a strong boy). The participants were three young children (two 5 years-old and one 6 years-old) with ASD, clients of a large-scale, home-based behavioral intervention provider. Their cognitive and linguistic abilities had been informally assessed in terms of overall capability of listening and responding to short stories, describing the properties of familiar objects, and detecting relevant differences and similarities. None of them had been previously sensitized to the specificities of metaphorical usages. The training included five phases: baseline; multiple exemplar training on oral basis; multiple exemplar training with visual aid where the experimenter taught to write a list of

features for each term of a metaphor on separate columns and then connect the matching features; generalization probes; post-training. The results showed clear and significant improvements from baseline, where the responses were null or very poor, to the successive steps. Very high percentages of adequate responses were found at the end of the training and post-training with novel metaphors, showing robust generalization to untrained items. The authors concluded that metaphorical reasoning, a major deficit in children with ASD, is a skill that can be successfully remediated by teaching how to identify and compare the features of the items in a metaphorical expression. In turn, this result suggests that other deficits in non-literal usages could also be remediated through specific teaching.

In a similar line, Lee et al. (2019) conducted a study in China with two boys and a girl with ASD. The oldest boy (8 years-old) had a Total IQ of 87 on the Wechsler Intelligence Scale for Children—4th edition (WISC-IV; Wechsler, 2003), and the youngest (5 years-old) had a Total IQ on the Wechsler Preschool and Primary Scale of Intelligence, Revised edition (WPPSI-R; Wechsler, 1989) of 115. Unfortunately, the girl did not receive an IQ assessment, and moreover, the study of her case was incomplete. All the children could read and understand at least 50 Chinese characters, which enabled them to read the written stimuli on power-point slides. The range of metaphors had been selected from spontaneous conversation in the classroom and books for Chinese elementary school children. There were two types of metaphors: those based on physical features (e.g., *Eyebrows are willow leaves*), and those based on abstract features (e.g., *Mumu is Superman*). The first slide showed the stimulus in a text (e.g., *Fang Fang is very beautiful: her eyebrows are two willow leaves*); the second slide showed a picture of the first term of the metaphor (*eyebrows*, in this case) while, in the third, the picture represented the second term (*willow leaves*, in this case). There were also cards with textual prompts to further facilitate comprehension. The sequence of the research design was the following: baseline, instructions, follow-up. The instructions were based on intraverbal training using iconic, echoic, and textual prompts. The goal was to have the child be able to detect one feature common to both terms of the metaphor (e.g., "*Both eyebrows and willow leaves are curvy*"). For the two children who completed the study the authors reported generalized understanding to untaught metaphors, and stability of the results at follow-up.

Regarding what has been called the "psycholinguistic" perspective, we must point out that the theoretical grounds are rather eclectic as they draw on multiple and more recent sources. It is to be noted that some procedures (e.g., "modeling", we will describe below) partly remind of the behavioral-analytic line just illustrated, but these are reconceptualized in terms of mental processes underlying verbal behavior. Among the major contributions to the psycholinguistic strand, we must consider semantic abilities, pragmatic inferential processes, Theory of mind, executive functions (for a review, Vulchanova et al., 2015). The ideas related to this perspective have changed the nature of the intervention. A case in point is Mashal and Kasirer's (2011) pioneering study. The authors described a treatment based on the analysis of the semantic relations that

characterize metaphors. Adapting a procedure used in brain lesions rehabilitation (Lundgren et al., 2006), the authors created thinking maps to train how to visualize the semantic relations in metaphors. The sample included 60 children, subdivided into three groups: children with ASD (m.a = 13.02 years), children with Learning Disabilities (LD, between 12 and 13), and typically-developing children (TD, between 12 and 13) who worked in small groups ranging from 2 to 4 children. Thinking maps are visual-verbal learning tools that provide graphic representations of the features shared by the two terms of the metaphoric expression (e.g., “train of thought”), thus providing an explicit basis for metaphor understanding. For instance, for “train of thought”, children had to write each term, “train” and “thought”, in two bubbles, and their semantic associations in surrounding bubbles. To make children understand this expression, the adults instructed them to write the appropriate associations between “train” and “thought”, which, in this case, could suggest the idea of “continuity” or of “connected thoughts”. The children had to exclude irrelevant associations between “train” and other words (e.g., “car” or “engines”) as well as between “thought” and other words (e.g., “brain” or “in the head”). In the authors’ opinion, generation of multiple associations enhances flexible thinking because it requires switching from one semantic feature to another until an adequate interpretation is achieved. Dependent variables were: metaphor (both novel and conventional) understanding, idioms understanding, executive function, as assessed by fluency and homophone meaning generation. The results showed that the LD group was able to use thinking maps to understand novel metaphors more efficiently than the ASD group. Conventional metaphor understanding correlated with homophone meaning generation, an ability associated with mental flexibility. In the ASD group, instead, homophone meaning generation correlated with novel metaphor understanding, which suggests the existence of an underlying mechanism likely to account for the ability to shift from one meaning to another in homophones, on the one hand, and the ability to grasp meanings in novel metaphors, on the other.

In a similar vein, Melogno et al. (2017, 2018, 2019, 2021) and Melogno and Pinto (2019), devised an intervention program to enhance metaphor understanding in children with ASD without intellectual disability nor deficits in basic language abilities (lexical or morphosyntactic). The program has been implemented with single children (Melogno et al., 2017, 2021) and a small group (Melogno and Pinto, 2019). The authors argue that the very structure of a metaphor (of the “X is Y” type) intrinsically creates a conflict between a literally false interpretation (“X is not Y”), and a metaphorically true interpretation (“X is metaphorically like Y”). This conflict can be reconciled by detecting the similarities between the semantic features of each term of the metaphor to justify the apparently anomalous association between these terms. On these grounds, metaphor understanding is viewed as a capability that calls into play two main types of metalinguistic abilities, namely, meta-semantic and meta-pragmatic. It is worth noting that this view is compatible with Ortony’s theory of metaphor (Ortony, 2012), according to which metaphor is not reducible

to comparison; rather, comparison is one of the possible ways to access metaphorical meaning.

In their studies, Melogno et al. (2017, 2018, 2019, 2021) and Melogno and Pinto (2019), hypothesized that, with a child with ASD, it is possible to: (1) inhibit the typical refusal that characterizes literal interpretations (“X is not Y”); (2) guide the child toward the recognition of similar features in the two terms of the metaphor; (3) train the child to use the meta-semantic and meta-pragmatic abilities required to recognize the above similarities. The authors devised three types of activities, implemented with a short but intense modality, consisting in the presentation of two mental strategies and a series of renaming exercises. The mental strategies were implemented in three main phases: modeling by the adult (a procedure inspired by behaviorism; Bandura, 1965), based on a thinking-aloud technique; joint adult-child activities; progressive dismantling of the adult’s scaffolding to promote the child’s autonomy (a procedure clearly inspired by Vygotskij (1962a,b), Wood et al. (1976).

The first strategy aimed at suggesting children to insert the connective “is like” between the two terms of the metaphor (“X is like Y”, instead of “X is Y”) to shift their focus from literal identification to metaphorical comparison. The second strategy, inspired by Mashal and Kasirer’s (2011) thinking maps, trained the child to detect common features in the two terms, and discard the irrelevant ones. The third strategy was inspired by the intuitive processes that typically-developing children spontaneously show (Winner, 1998), and encouraged to rename objects, images (e.g., stop signal, tea-pot, sea waves, etc.), and individuals (e.g., a child) in a metaphorical way. For instance, a metaphorical renaming of a cleaning rag could be: “a wig”, or “hair”.

At meta-pragmatic level, the adult told the child two stories ending with the same metaphorical sentence which was interpretable in two different ways. The appropriate inference was one of three alternatives, and required to integrate the literal meaning of the sentence with contextual information and the speaker’s communicative intention. It is to be noted, however, that in this framework the appropriate alternative is not to be intended as the “sole true response” as the same metaphor can be attributed several *plausible* meanings among those inferable from the context.

The results obtained in all the studies implemented with this treatment modality appeared promising, although some differences emerged in relation to the nature of the metaphors, sensory (e.g., “A loaf is a stone”) or physico-psychological (e.g., “Mark is a safe”) (for this distinction, see Winner, 1998; Lecce et al., 2019), the latter seeming more complex to process. This result suggests to diversify the discursive strategies in joint adult-child activities in relation to the semantic typology of metaphors (Cameron, 2003; Rucińska et al., 2021).

Midway between assessment and training, Tzuriel and Groman (2017) used a dynamic assessment approach to assess metaphorical construction, proverbial understanding, and analogical reasoning in children with high-functioning autism compared to typically-developing children (m.a. = 112 months in each group). The two groups were matched by

age, gender, WISC-IV vocabulary subtest (Wechsler, 2003), and socioeconomic status. The interest of this study relies on the fact that the type of mediation used by the authors represents an initial intervention already implemented during the assessment. “Mediation in this approach is delivered by a set of predetermined hints that range from general to specific. The examiner stops providing hints when the child reaches the level of independent task solution” (Tzuriel and Groman, 2017, p. 45).

DISCUSSION

The studies described so far might seem similar at first sight, although the underlying theoretical grounds are quite distant from one another. Apparently, each study aimed at having children with ASD grasp the semantic features which can highlight the commonalities shared by the single terms of the metaphor, and thereby, illuminate the consistency of the metaphor itself. However, the mental pathways elicited by each type of intervention are based on different cognitive and linguistic processes. For instance, in the Lee et al.’s (2019) study, the authors themselves admit as a limitation that it is uneasy to understand the role of iconic, echoic, and textual prompts in relation to the expected response. It should be noted, in addition, that the cognitive and linguistic status the authors attribute to this response is that of a learned “verbal behavior” (Skinner, 1957). On the other hand, in the type of training devised in the psycholinguistic framework, the stress is on the gradual co-construction of the processes that will bring children to an appropriate elaboration of the metaphor. While the adult offers a series of mediating instruments, children must activate a considerable range of cognitive processes, and bring them to a meta-level (Pinto et al., 2012; Melogno et al., 2022). In addition, they must also retrieve a large body of semantic knowledge, knowledge about the world, and use the appropriate language to express this knowledge. In particular, children must learn how to inhibit the prepotent response that would irreflexively bring them to interpret literally “X” as being *identical* to “Y” (Houdé, 2020), instead of metaphorically *assimilable* to “Y”. Children must also discriminate beyond the surface of “X” and “Y” the features which are clearly uncomparable from others which, on the contrary, make the similarity between “X” and “Y” plausible. Children must psychologically *accept* that this similarity has not a logical nor a real ground, but rather a metaphorical ground. This complex process requires to shift from one semantic feature to another, quickly and adequately, and update the range of commonalities that justify the metaphorical comparison between “X” and “Y”.

Lastly, if the metaphor is contextualized in a story, a meta-pragmatic ability must also come into play to infer the speaker’s communicative intention. This pragmatic focus is precisely what characterizes the “MetaCom” training (Tonini et al., 2022), targeted for school-age typically- developing children, which can potentially inspire also interventions for clinical populations.

Currently, any statement about the validity of the interventions described so far is inconclusive due to the following factors: scarce empirical evidence, uneasy comparisons between

the results due to heterogeneous ages, neuropsychological and cultural profiles of the children with ASD, unclear role of the specific techniques used in the various interventions.

Future research on the relationships between ASD and figurative language, metaphor in particular, will be confronted with several challenges. Starting from methodology, researchers should refine experimental designs (using, for example, active control groups), widen the range of typologies of metaphors, addressing semantic and syntactic variations (e.g., nominal, referential metaphors but also metaphorical verbs and adjectives), and study post-training generalizations to everyday life situations. Another challenging point is the analysis of the developmental trajectories in children with ASD, which will allow us to better understand what we can expect in the course of development, and identify the optimal phases to implement treatments (Melogno et al., 2018). In addition, developmental and educational issues will have to be contextualized in the cultural framework (Di Biasi et al., 2016) that shapes the cognitive processes under focus.

We wish to end this short review by addressing one of the major theoretical challenges emerging from the studies described so far. From the first explorations by Persicke et al. to the more recent studies, by Melogno et al., it appeared that the child with ASD does not limit him/herself to *understand* metaphors, more or less adequately, but *produces* metaphors on his/her own, with sometimes striking spontaneity and originality. This result is in line with Kasirer and Mashal’s studies (Kasirer and Mashal, 2014, 2016; Kasirer et al., 2020), which explored the capability of children with ASD to generate novel metaphors, and found that these children were more creative than their typically-developing peers. Interestingly, a study conducted in a totally different theoretical framework, namely the embodied-enactive (Rucińska et al., 2021) analyzed the connection between metaphor production and comprehension during a conversation between an adult and a young child with ASD. The verbal exchange highlighted how the spontaneous production of a metaphor by the child triggered a redefinition of the same metaphor by the adult, which, in turn, rebounded on the child’s comprehension and new production.

Back to the psycholinguistic studies, the following example, from Melogno et al. (2021), illuminates a similar production-comprehension dynamics in adult-child conversation. As part of the training, Lorenzo, a child with ASD (9.8 years-old), and a special passion for mushrooms and ancient temples, was requested to rename objects metaphorically. Specifically, he had to rename a mushroom, scientifically called “*Amanita phalloides*”, a denomination Lorenzo knew. The adult reported the opinion of a hypothetical child, we will reproduce in Spanish, the language of the article. “Sabes que otro niño me dijo ‘paraguas’ y me explicó que la seta es como un paraguas porque el paraguas, si está abierto, tiene la misma forma...¿ Tú, qué nombre nuevo le darías a esta imagen? (“You know, another child told me ‘umbrella’, and explained to me that a mushroom is like an umbrella because, when it’s open, it has the same shape... And you, what new word would you give to this picture?”). Lorenzo renamed the mushroom: “The Temple of Hercules Victor” (an ancient Roman temple) explaining that

“el sombrero de la ‘Amanita phalloides’ tiene forma circular como el techo del templo de Hercules vencedor... Claro que la seta no tiene veinte columnas corintias, pero el techo es similar por su forma y su color”... (“The hat of the ‘Amanita phalloides’ has a circular form like the temple of Hercules Victor... Clearly, the mushroom doesn’t have the twenty Corinthian columns but the roof is similar for shape and color”). When the adult asked Lorenzo further renamings of the mushroom, the child provided a list of five more names in a row: “paraguas abierto”, “sombrija japonesa”, “lampara de escritorio o de salon”, “mesita redonda de jardín”, “bandeja para dulces” (“open umbrella”; “Japanese umbrella”, “desk or living-room lamp”; “small round garden table”; “cake stand”). When the adult asked him how all these names came to his mind, Lorenzo replied: “No lo sé” (“I don’t know”)... “Me vinieron a la cabeza” (“they came to my mind”)... “Si lo pienso bien, por la forma” (“Upon reflection, because of the shape”) (Melogno et al., 2021, p. 47).

We may wonder whether this remarkable expression of verbal creativity is of the same nature of the spontaneous productions we can also find in typically-developing preschoolers, as Asperger had already noticed in 1944 (Asperger, 1944), or reflects an authentic meta-level. Lorenzo’s justification based on

shape would suggest a semantic meta-level. A further meta-pragmatic level might be reached in case the child addressed a hypothetical friend the following way: “the ‘Amanita phalloides’ is a living-room lamp”, assuming, moreover, that his friend would understand the metaphor.

Future research will have to explore more in depth these complex metacognitive and metalinguistic aspects in children with ASD without intellectual disability when they are faced with metaphorical language. Within this broad category, however, we should identify those subgroups of children (Norbury, 2005; Gernsbacher and Pripas-Kapit, 2012; Kalandadze et al., 2018) who understand and/or produce at least some typologies of metaphors. Devising interventions for these children is particularly challenging because, for them, metaphors are actually strengths which therefore deserve to be enhanced at communication and also at learning level (Ortony, 1975).

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

REFERENCES

- American Psychiatric Association (2013). *Diagnostic and Statistical Manual of Mental Disorders*, 5th Edn. Arlington, VA: American Psychiatric Publishing.
- Asperger, H. (1944). Die ‘Autistischen Psychopathen’ im Kindesalter. *Archiv für Psychiatrie und Nervenkrankheiten* 117, 76–136. doi: 10.1007/BF01837709
- Bandura, A. (1965). Vicarious processes: a case of no-trial learning. In: *Advances in Experimental Social Psychology*, ed L. Berkowitz, Vol. 1 (New York, NY: Academic Press). p. 1–55.
- Cameron, L. (2003). *Metaphor in Educational Discourse. Advances in Applied Linguistics*. London, UK: Continuum.
- Chahboun, S., Vulchanov, V., Saldaña, D., Eshuis, H., and Vulchanova, M. (2017). Can you tell it by the prime? A study of metaphorical priming in high-functioning autism in comparison with matched controls. *Int. J. Lang. Comm. Disord.* 52, 766–785. doi: 10.1111/1460-6984.12314
- Dennis, M., Lazenby, A., and Lockyer, L. (2001). Inferential language in high-functioning children with autism. *J. Autism Dev. Disord.* 31, 47–54. doi: 10.1023/A:1005661613288
- Di Biasi, S., Trimarco, B., D’Ardia, C., Melogno, S., Meledandri, G., and Levi, G. (2016). Psychological adjustment, social responsiveness and parental distress in an Italian sample of siblings of children with high-functioning autism spectrum disorder. *J. Child Fam. Stud.* 25, 883–890. doi: 10.1007/s10826-015-0256-x
- Gernsbacher, M. A., and Pripas-Kapit, S. R. (2012). Who’s missing the point? A commentary on claims that autistic persons have a specific deficit in figurative language comprehension. *Metaphor. Symbol* 27, 93–105. doi: 10.1080/10926488.2012.656255
- Gibbs, R. (1994). *The Poetics of Mind: Figurative Thought, Language and Understanding*. Cambridge: Cambridge University Press.
- Gold, R., and Faust, M. (2010). Right hemisphere dysfunction and metaphor comprehension in young adults with Asperger syndrome. *J. Autism Dev. Disord.* 40, 800–811. doi: 10.1007/s10803-009-0930-1
- Happé, F. (1993). Communicative competence and theory of mind in autism: a test of relevance theory. *Cognition* 48, 101–119. doi: 10.1016/0010-0277(93)90026-R
- Happé, F. (1995). Understanding minds and metaphors: insight from the study of figurative language in autism. *Metaphor Symb. Act.* 10, 275–295. doi: 10.1207/s15327868ms1004_3
- Hayes, S. C., Barnes-Holmes, D., and Roche, B. (eds.). (2001). *Relational Frame Theory. A Post-Skinnerian Account of Human Language and Cognition*. New York, NY: Plenum Press.
- Houdé, O. (2020). *L’inhibition au service de l’intelligence: Penser contre soi-même*. Paris: PUF.
- Kalandadze, T., Bambini, V., and Næss, K. (2019). A systematic review and meta-analysis of studies on metaphor comprehension in individuals with autism spectrum disorder: do task properties matter? *Appl. Psycholing.* 40, 1421–1454. doi: 10.1017/S0142716419000328
- Kalandadze, T., Braeken, J., Brynskov, C., and Næss, B. K. A. (2022). Metaphor comprehension in individuals with autism spectrum disorder: core language skills matter. *J. Autism Dev. Disord.* 52, 316–326. doi: 10.1007/s10803-021-04922-z
- Kalandadze, T., Norbury, C., Nærland, T., and Næss, B. K. A. (2018). Figurative language comprehension in individuals with autism spectrum disorder: a meta-analytic review. *Autism*, 22, 99–117. doi: 10.1177/1362361316668652
- Kasirer, A., Adi-Japha, E., and Mashal, N. (2020). Verbal and figural creativity in children with autism spectrum disorder and typical development. *Front. Psychol.* 11, 559238. doi: 10.3389/fpsyg.2020.559238
- Kasirer, A., and Mashal, N. (2014). Verbal creativity in autism: comprehension and generation of metaphorical language in high-functioning autism spectrum disorder and typical development. *Front. Hum. Neurosci.* 8, 615. doi: 10.3389/fnhum.2014.00615
- Kasirer, A., and Mashal, N. (2016). Comprehension and generation of metaphors by children with autism spectrum disorder. *Res. Autism Spectr. Disord.* 32, 53–63. doi: 10.1016/j.rasd.2016.08.003
- Lecce, S., Ronchi, L., Del Sette, P., Bischetti, L., and Bambini, V. (2019). Interpreting physical and mental metaphors: is theory of mind associated with pragmatics in middle childhood? *J. Child Lang.* 46, 393–407. doi: 10.1017/S030500091800048X
- Lee, G. T., Xu, S., Zou, H., Gilic, L., and Lee, M. W. (2019). Teaching children with autism to understand metaphors. *Psychol. Rec.* 69, 499–512. doi: 10.1007/s40732-019-00355-4
- Lundgren, K., Brownell, H., Soma, R., and Cayer-Meade, C. (2006). A metaphor comprehension intervention for patients with right hemisphere brain damage: a pilot study. *Brain Lang.* 99, 60–70. doi: 10.1016/j.bandl.2006.06.044

- Martin, I., and McDonald, S. (2004). An exploration of causes of non-literal problems in individuals with Asperger syndrome. *J. Autism Dev. Disord.* 34, 311–328. doi: 10.1023/B:JADD.0000029553.52889.15
- Mashal, N., and Kasirer, A. (2011). Thinking maps enhance metaphoric competence in children with autism and learning disabilities. *Res. Dev. Disabil.* 32, 2045–2054. doi: 10.1016/j.ridd.2011.08.012
- Melogno, S., D'Ardia, C., Pinto, M. A., and Levi, G. (2012a). Explaining metaphors in high functioning autism spectrum disorder children: a brief report. *Res. Autism Spectr. Disord.* 6, 683–689. doi: 10.1016/j.rasd.2011.09.005
- Melogno, S., and Pinto, M. A. (2019). Un programme d'intervention pour améliorer la compréhension de métaphores dans le Trouble du Spectre de l'Autisme. *Enfance* 2, 223–239. doi: 10.3917/enf2.192.0223
- Melogno, S., Pinto, M. A., and Di Filippo, G. (2018). Monitoring developmental trajectories in novel metaphor comprehension in children with ASD: a case study. *Neuropsychol. Trends* 22, 57–71. doi: 10.7358/neur-2017-022-melo
- Melogno, S., Pinto, M. A., and Di Filippo, G. (2019). Sensory and psychosocial metaphor comprehension in children with ASD: a preliminary study on the outcomes of a treatment. *Brain Sci.* 7, 85. doi: 10.3390/brainsci7070085
- Melogno, S., Pinto, M. A., and Lauriola, M. (2022). Becoming the metalinguistic mind: The development of metalinguistic abilities in children from 5 to 7. *Children (Basel)*. 9, 550. doi: 10.3390/children9040550
- Melogno, S., Pinto, M. A., and Levi, G. (2012b). Metaphor and metonymy comprehension in ASD children: a critical review from a developmental perspective. *Res. Autism Spectr. Disord.* 8, 1289–1296. doi: 10.1016/j.rasd.2012.04.004
- Melogno, S., Pinto, M. A., and Orsolini, M. (2017). Novel metaphors comprehension in a child with high-functioning autism spectrum disorder: a study on assessment and treatment. *Front. Psychol.* 7, 2004. doi: 10.3389/fpsyg.2016.02004
- Melogno, S., Scalisi, T. G., Pollice, C., and Pafumi, M. L. (2021). Afrontar el significado metafórico de las palabras: un tratamiento con un niño con trastorno del espectro autista. *J. Appl. Psycholing.* 1, 29–46. doi: 10.19272/202107702003
- Norbury, C. F. (2005). The relationship between theory of mind and metaphor: evidence from children with language impairment and autistic spectrum disorder. *Br. J. Dev. Psychol.* 23, 383–399. doi: 10.1348/026151005X26732
- Olofson, E. L., Casey, D., Oluyedun, O., Van Herwegen, J., Becerra, A., and Rundblad, G. (2014). Youth with autism spectrum disorders comprehend lexicalized and novel primary conceptual metaphors. *J. Autism Dev. Disord.* 44, 2568–2583. doi: 10.1007/s10803-014-2129-3
- Ortony, A. (1975). Why metaphors are necessary and not just nice. *Educ. Theory* 1, 45–53. doi: 10.1111/j.1741-5446.1975.tb00666.x
- Ortony, A. (2012). *Metaphor and Thought*. Cambridge: Cambridge University Press.
- Persicke, A., Tarbox, J., Ranick, J., and St. Clair, M. (2012). Establishing metaphorical reasoning in children with autism. *Res. Autism Spectr. Disord.* 6, 913–920. doi: 10.1016/j.rasd.2011.12.007
- Pinto, M. A., Iliceto, P., and Melogno, S. (2012). Argumentative abilities in metacognition and in metalinguistics. A study on University students. *Eur. J. Psychol. Educ.* 27, 35–58. doi: 10.1007/s10212-011-0064-7
- Rucińska, Z., Fondelli, T., and Gallagher, S. (2021). Embodied imagination and metaphor use in autism spectrum disorder. *Healthcare* 9, 200. doi: 10.3390/healthcare9020200
- Rundblad, G., and Annaz, D. (2010). The atypical development of metaphor and metonymy comprehension in children with autism. *Autism* 14, 29–47. doi: 10.1177/1362361309340667
- Skinner, B. F. (1957). *Verbal Behavior*. New York, NY: Appleton-Century-Crofts.
- Stewart, I., and Barnes-Holmes, D. (2001). Understanding metaphor: a relational frame perspective. *Behav. Anal.* 24, 191–199. doi: 10.1007/BF03392030
- Tonini, E., Lecce, S., Bianco, F., Canal, P., and Bambini, V. (2022). Efficacy and benefits of the MetaCom training to promote metaphor comprehension in typical development. *First Lang.* 42, 1–31. doi: 10.1177/01427237221081201
- Tzuriel, D., and Groman, T. (2017). Dynamic assessment of figurative language of children in the autistic spectrum: the relation to some cognitive and language aspects. *J. Cogn. Educ. Psychol.* 16, 38–63. doi: 10.1891/1945-8959.16.1.38
- Van Herwegen, J., and Rundblad, G. (2018). A cross-sectional and longitudinal study of novel metaphor and metonymy comprehension in children, adolescents, and adults with autism spectrum disorder. *Front Psychol.* 9, 945. doi: 10.3389/fpsyg.2018.00945
- Vulchanova, M., Saldaña, D., Chahboun, S., and Vulchanov, V. (2015). Figurative language processing in atypical populations: the ASD perspective. *Front. Hum. Neurosci.* 9, 24. doi: 10.3389/fnhum.2015.00024
- Vygotskij, L. S. (1962a). *Mind in Society. The Development of Higher Psychological Processes*. Cambridge: Harvard University Press.
- Vygotskij, L. S. (1962b). *Thought and Language*. Cambridge: The MIT Press.
- Wechsler, D. (1989). *Wechsler Preschool and Primary Scale of Intelligence (Rev. ed.)*. San Antonio, TX: Psychological Corporation.
- Wechsler, D. (2003). *Wechsler Intelligence Scale for Children*. 4th Edn. San Antonio, TX: Psychological Corporation.
- Winner, E. (1998). *The Point of the Words*. Harvard: Harvard University Press.
- Wood, D., Bruner, J. S., and Ross, G. (1976). The role of tutoring in problem solving. *J. Child Psychol Psychiatry* 17, 89–100. doi: 10.1111/j.1469-7610.1976.tb00381.x

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Melogno and Pinto. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.