‘Broccoli is candy’: the role of metaphors in children’s persuasive communication

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Abstract: Persuasion is a complex communicative process aiming at influencing others’ beliefs or behaviors. Imbuing everyday communication, persuasion is a crucial skill for children to manage social interactions successfully. While theoretically persuasion has been linked with the mastery of figurative language and with pragmatics more broadly, there is a scarcity of empirical evidence exploring the relationship between persuasion and metaphor skills. Here we tackle this issue in early childhood by examining whether individual differences in metaphor skills are related to those in persuasion. A sample of 167 children (age 4-6 years) was assessed for persuasive abilities alongside metaphor comprehension and production, in addition to vocabulary and working memory skills as control variables. Results showed an improvement in persuasive skills at 5 years of age. Across ages, children preferred to use positive persuasive strategies (i.e., offering rewards) over negative ones (i.e., punishments), while psychological strategies relying on mitigation and modeling were rarely used. Regardless of the type of strategy, persuasion correlated positively with vocabulary skills. Interestingly, greater use of psychological persuasive strategies was associated with better metaphor production skills (being conversely hampered by working memory), while no effect of metaphor comprehension was found. Overall, these findings suggest that some aspects of metaphor skills, within the broader set of pragmatic competencies, might be a driving factor in achieving a high-level persuasive style. Such aspects possibly deal with the functions of metaphors to favor flexible conceptualization and social use of language.

Keywords: language acquisition; persuasive skills; communication; figurative language; metaphor production

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Introduction

Be it a child who wants to spend more time in front of the TV, a charismatic leader who needs to win the loyalty of his constituents, or a lawyer who has to convince the jury of his client's innocence, making information appear convincing or persuasive towards one's interests is a key aspect of human communicative competence. The ability to persuade others is a challenge that individuals undertake early in development and then need to adapt to a wide range of situations, drawing on multiple linguistic and psychological resources. In this study, we investigated the blooming of persuasion through early childhood, while considering its cognitive and linguistic correlates and, in particular, the role of receptive and expressive metaphor skills.

The conceptualization of persuasion can be traced back to classical rhetorical studies, particularly to Aristotle, who conceived persuasion as the intrinsic purpose of the art of oratory (Montanari, 1996). Integrating more recent considerations, persuasion is defined as a complex communicative process aiming at influencing others' beliefs or behaviors (Freeley & Steinberg, 2009). Furthermore, persuasion also refers to the set of cognitive processes responding to the communication of a message whereby interlocutors change their "attitudes or behavior regarding an issue", via the use of linguistic tools (Perloff, 1993) with the intention of modifying the cognitive environment of the audience (Sperber & Wilson, 1986). In this respect, persuasion relies both on expressive aspects (dealing with the verbal form in which it is delivered) and psychological elements used to achieve a perlocutionary goal, i.e., the consequential effects on the receiver. In other words, persuasion is successful not only by delivering a proposal or suggestion but also depends on the receiver adopting a certain psychological attitude (Sbisà, 2013).

Focusing on the linguistic level, accounts emphasize the pragmatic nature of persuasion, pointing out that nothing like the ability to engage and persuade others to think, say, or do what we would like them to do allows us to participate in social communication (Dillard, 2010). Indeed, to achieve different persuasive goals, speakers need a variety of strategies, which include structural linguistic mechanisms such as the use of requests, referential, expressive, and phatic utterances (Nord, 2008) but mostly

exploit pragmatics-based tools (Khafaga et al., 2023). Among the wide ensemble of pragmatic devices, some are said to contribute more (or more effectively) than others to achieving strong persuasive effects (Baldi, 2020): being able to evoke a common cognitive ground, a sort of "shared territory" favoring possible joint visions and solutions (Bülow-Møller, 2005). These include implicatures and presuppositions (Lombardi Vallauri, 2022) and, in particular, the clever use of figurative language, with the most prominent role played by metaphor (Sopory & Dillard, 2002a; Van Patten, 2013).

The link between metaphor and persuasion can be best understood by inspecting the definition and scope of metaphor itself. Just like persuasion, metaphor has a two-fold nature, including specific linguistic processes and psychological effects. According to accounts in the pragmatics of language, metaphors are loose uses of words (Carston, 2010), by which concepts conveyed by lexical entries are broadened or narrowed towards the creation of novel and *ad hoc* concepts. For instance, upon hearing an utterance such as *Get the nugget of ice cream in the refrigerator,* the listener needs to use the context to first expand the lexical denotation of the metaphorically used word *nugget* (dropping the feature of being made out of gold, while promoting the aspects related to being precious or a small quantity) and then derive the intended meaning of the sentences as referring to a small amount of very good ice cream (for a more detailed description, see, e.g., Sperber & Wilson, 2008). Mastering these processes relies on a complex interplay of cognitive and neural mechanisms (Bischetti et al., 2024) that reflect the pinnacle of our linguistic and communicative skills and mature throughout development, going through different stages (Falkum, 2019; Lecce et al., 2019; Pouscoulous, 2014).

At a more psychological level, metaphors are deeply intertwined with our conceptualization of various phenomena, particularly complex ones (Lakoff & Johnson, 1980). The list of cognitive and social functions of metaphor is long and includes favoring the processing of complex concepts from different points of view. Metaphors can make technical concepts accessible to non-experts and provide a deep conceptualization of phenomena by eliciting thoughts about a topic and increasing the memorability of concepts. Moreover, from the emotional point of view, metaphors can help in expressing feelings (Christidou et al., 2004; Fainsilber & Ortony, 1987; Katz, 1992). For these reasons, metaphorical devices in different modalities (e.g., verbal and visual) are largely used in politics and advertising to persuade people to buy certain products and modify certain behaviors or ideas (Burgers et al., 2016; McQuarrie & Phillips, 2005). Prominent psychological accounts identify different ways in which metaphors achieve conceptualization and, in turn, persuasion (Holyoak & Stamenkovíc, 2018; Sopory & Dillard, 2002a). According to cognitive linguistics, metaphor promotes

conceptualization via embodied cognitive mappings, and such processes of mental simulation are key for the comprehension of the persuasive message (Sopory & Dillard, 2002a). Differently, for the analogy account, metaphor stimulates the identification of similarities between concepts (Holyoak & Stamenkovíc, 2018) and, in turn, focusing on similar target-base relations evokes a richer set of associations in semantic memory, which ultimately leads to greater elaboration and persuasion compared to literal language.

Across studies, what emerges is especially the flexibility of metaphors in conveying messages of various kinds, promoting either negative or positive inferences. A recent review pointed out that metaphors are often employed in political discourse to emphasize negative consequences while downplaying positive ones (e.g., on immigration policies), with large-scale social consequences (Boeynaems et al., 2017). Studies on visual metaphors in advertising reported that metaphors suddenly convey aspects related to rewards or positive outcomes of certain actions. For example, a detergent was advertised with a picture of a bomb on the side; participants reported that they immediately perceived aspects related to the effectiveness of the product, in the absence of consideration of negative features related to the bomb (McQuarrie & Phillips, 2005).

The *metaphorical advantage* in persuasive communication was confirmed by a meta-analysis of 29 studies comparing literal versus metaphorical uses in persuasive statements, which showed that metaphors ensured attitude changes to a greater extent. This advantage over literal language was explained in terms of a facilitatory effect of metaphors in integrating the current message (i.e., persuasive statements) into the interlocutor's prior knowledge (Sopory & Dillard, 2002b). Consistently, the ability to master metaphors was shown to be key in promoting the understanding of scientific concepts (i.e., climate change-related) in children, while modulating psychological attitudes toward environmental issues and proactive behavior (Pompei et al., 2024). Overall, metaphor seems to reach persuasive effects via multiple psychological processes (Ottati & Renstrom, 2010), thus constituting a true high-level persuasive strategy, capable of changing the interlocutor's mental state, attitudes, and behaviors toward the topic. Specifically, metaphorical skills seem to provide a flexible conceptual platform through which ideas can be broadened, narrowed, and creatively associated to strengthen persuasive effects. However, despite the numerous connections between persuasive strategies and metaphors highlighted above, a clear understanding of whether and how persuasive and metaphorical abilities are related to one another during development is still missing.

The study of persuasion is a relatively underexplored area within the field of developmental social psychology. Investigations on children's at-home conversations have reported that children as young as 5 years exhibit simple persuasive tactics in their family interactions (Bartsch et al., 2011) or with their play partners (Köymen et al., 2016). During development, persuasion skills are also articulated in different strategies that begin with the acquisition of the simpler ones such as positive (i.e., based on the reward system or emphasizing positive outcomes) and negative (i.e., based on the punishment and threat system, or focused on negative outcomes), and that peak with the elaboration of higher-level strategies, involving mitigation (e.g., using trade-offs, providing alternative strategies for approaching the phenomenon) and modeling, e.g., lead by example (Peterson et al., 2018; Lonigro et al., 2017). Studies have also shown that persuasive skills mature together with other skills, including Theory of Mind (ToM), building on the idea that being able to self-represent others' beliefs and mental states is necessary to produce strategies useful to effectively influence others' beliefs, opinions, and behaviors (Barajas et al., 2022; Lonigro et al., 2017). Other studies focused on the role of language and showed the key role of high-level linguistic skills in the transition toward the most complex forms of persuasive attempts. Nippold et al. (2005) reported that, while children as early as age 11 showed adult-like performance for syntactic and semantic features of the persuasive production, adults outperformed children and adolescents in discourse-pragmatic dimensions, also providing different persuasive argumentations and using different types of strategies. Consistently, a pioneering work by Crowhurst & Piche (1979) reported that young adolescents, when asked to direct persuasive attempts to different target audiences (e.g., teachers vs. peers) via essay, still struggle in modulating their linguistic repertoire, taking into account the interlocutor. More recent studies have suggested that persuasive performance in adolescents may be related to a large variety of discourse features, also depending on working memory skills (Heilmann et al., 2020). This sparse evidence on the importance of high-level language skills suggests that pragmatics and metaphor, in particular, as a fundamental aspect of pragmatic competence (Domaneschi & Bambini, 2020) might play a role in the maturation of persuasive skills.

The Present Study

In the present study, we investigated the developmental pathway of persuasive communication in early childhood, focusing on the role of metaphorical competence while accounting for more general linguistic and cognitive abilities. Specifically, we considered the role of vocabulary, working memory, and metaphor expressive and receptive skills in determining children's use of different persuasive strategies, namely differentiating between those utterances focusing on positive or negative

outcomes or applying psychological mitigation and modeling strategies. Our hypotheses were that: (a) persuasion skills begin to develop at around 5 years of age, in line with previous observational studies (Bartsch et al., 2011); (b) metaphor skills scaffold high-level persuasive strategies over and above general linguistic and cognitive skills. We based the latter prediction on two main findings emerging from the literature described above: first, the role that metaphor use plays in modulating psychological processes during high-level persuasive argumentation (Ottati & Renstrom, 2010), also in children (Pompei et al., 2024), and second, the role of high-level language aspects in the development of persuasive skills (Nippold et al., 2005). These hypotheses were explored with a cross-sectional design study in which we employed an elicitation task for persuasion assessment and both receptive and expressive tasks for metaphor skills.

Method

Participants

A sample of 246 children ranging in age from four to six years was enrolled in the present study. Children were recruited from local schools and kindergartens located in Lombardy, Italy. Before running the data analysis, we excluded children who met one or more of the following criteria: being diagnosed with intellectual disabilities or neurodevelopmental disorders, having hearing deficits, or not having acquired the Italian language before the age of 3. The final sample included 167 children including 52 4-year-old children (age range: 4;0, 4;11; *M* age = 4;6), 76 5-year-old children (age range: 5;0, 5;11; *M* age = 5;5), and 39 6-year-old children (age range: 6;0, 6;11; *M* age = 6;6). We ran an after-the-fact power analysis (O'Keefe, 2007) focusing on the main research aim, namely the relationship between persuasion and metaphor skills. We found that with 167 participants and $\alpha = .05$, we achieved a high statistical power ($1-\beta = .99$) to detect a moderate effect (in line with the overall effect $r = .42$ reported in the meta-analysis by Sopory & Dillard (2002b). Both parents signed written informed consent, and children were provided with age-appropriate information about their participation in the study. The study was approved by the Local Ethical Committee of the Department of Brain and Behavioral Sciences of the University of Pavia (n. protocol 029/2019) and followed the principles of the Declaration of Helsinki.

Design and Procedure

Each child took part in two individual sessions administered in a silent place during school time. Each session lasted approximately 20 minutes. During the first session, children were assessed for their vocabulary and working memory, while the second

session was dedicated to the assessment of metaphor skills (both receptive and expressive) and persuasive skills.

Measures

Vocabulary. The Italian version of the Peabody Picture Vocabulary Test - Revised (PPVT-R; Stella et al., 2000) was used to assess children's vocabulary skills, which has been shown to have excellent split-half reliability value (r = .88, Dunn & Dunn, 1981) and high validity against the McCarthy Scales of Children's Abilities (r = .79, Naglieri & Maxwell, 1981). The PPVT-R includes 175 verbal stimuli and measures receptive vocabulary with a picture selection task: children are asked to choose, among four images, the one that best describes the meaning of the word uttered by the experimenter. Following the standard procedure, for each child, the chronological age is used to set individual test starting points. An incorrect response to any of the first 8 benchmark items results in a retraction of the starting point. Six consecutive errors in an 8-item block result in the test interruption. The total score consists of the number of correct answers (score range: 0-175).

Working Memory. Working Memory was assessed using the backward word recall task (Lanfranchi et al., 2004), a largely used task included in a battery measuring verbal working memory globally quite reliable (overall Cronbach's alpha = .56). In this task, children are presented with lists of two to five words and asked to repeat the list immediately, in reverse order. Two items for each of the four levels of difficulty (2-word; 3-word; 4-word; 5-word trials) are administered; failure in both items corresponds to the interruption of the test. The total score consists of the number of correctly achieved levels (score range: 0–8).

Metaphor Comprehension. To assess metaphor comprehension, we used the newly developed multiple-choice version of the Physical and Mental Metaphor task (Lecce et al., in prep.), originally developed in the verbal explanation task format (Del Sette et al., 2020; Lecce et al., 2019). The task was adapted by creating multiple choice options for 6 verbal items extracted from the verbal explanation version of the task, plus 4 novel metaphors, which show acceptable item-total correlation (range of Pearson's correlation .37 < rs < .57). The test includes 10 metaphors: 5 physical (i.e., metaphors that capitalize on physical properties, such as *Dancers are feathers*) and 5 mental (i.e., metaphors that capitalize on mental or psychological aspects, such as *The teacher is an icicle*). Children are asked to select the best fitting explanation for each metaphor, choosing among a set of three options, presented both verbally and visually (correct: physical, e.g., *They are light*, with an image representing dancers jumping almost weightless; mental, e.g., *She is strict*, with an image representing a teacher

scolding her pupils; incorrect literal: physical, e.g., *They are dressed in white*, with an image representing white dressed dancers; mental, e.g., *She likes cold things*, with an image representing the teacher eating an icicle; incorrect unrelated: physical, e.g., *They are short*, with an image representing short dancers; mental, e.g., *She likes to sing*, with an image representing the teacher singing). Answers are scored as correct (1) for an appropriate interpretation or incorrect (0) for literal and unrelated interpretation (score range: 0-10).

Metaphor Production. To assess metaphor production abilities, we adapted the elicitation task by Cortés et al. (2018). This task is composed of 4 items in which children are given literal prompts and asked to produce metaphors. Based on our sample, the task showed acceptable internal consistency (Cronbach's alpha = .78) and excellent inter-rater reliability (92% agreement between coders; Pompei et al., 2023). More in detail, children are provided with a brief description of an object and then instructed to change the prompted literal word with a metaphoric equivalent (e.g., to describe a dog being white without using the word 'white'). Salient metaphors (e.g., *The dog is a cloud*) are defined as those figurative associations for which the implicated meaning matches – on a common ground based on shared word knowledge – with the prompt word (e.g., *white*), and are scored 2 points; similes (e.g., *The dog is like a cloud*) and non-salient metaphors (e.g., *The dog is an ice-cream*) defined as metaphors built around a vehicle that highlight features only marginally matching with the prompt word 1 point, and literal or no answers were scored 0 points (score range: 0-8).

Persuasion. To measure persuasive skills, we adapted the interactive task by Peterson and colleagues (2018). In this task, children sit at the table with the experimenter interacting with a puppet called Mattia. The puppet is introduced as a peer to them. The task consists of two items that require the child to persuade the puppet to perform an action, i.e., to eat broccoli and to brush his teeth, using only words. In the original version of the task, two authors independently coded a random set of 33 children's complete transcripts (i.e., 198 responses representing 33% of the 594 total responses produced across six episodes per child) showing an excellent inter-rater reliability (94% agreement between coders). Each item includes three trials: in the first two attempts, the puppet provides negative feedback to persuasive attempts; after the negative feedback, the experimenter challenges the child to try again. Regardless of the quality of the child's persuasive production, the third trial is always successful (e.g., *Great! You have convinced him*!), and the puppet eventually agrees to perform the action (See Fig.1. for the schematic representation of the task).

Following the recommendations proposed by Peterson et al. (2018), unrelated answers or no answers are scored as 0; occurrences of persuasive arguments are

counted as 1 and summed up: for each child, the final score consists of the total number of persuasive statements uttered by the child. Repeated arguments within the same item are not considered. Persuasive arguments are further categorized as Positive, Negative, or Psychological. The Positive label refers to sentences that use good consequences and rewards to achieve persuasion (e.g., *If you brush your teeth, then they become strong*; *If you eat it, we'll give you a gift*). The Negative label refers to sentences that exploit threats and punishment to reach the aim (e.g., *If you don't brush your teeth, you get cavities*; *If you don't eat broccoli, you stay small*). The Psychological strategies are statements introducing a compromise or a modulation of the request as an incentive to achieve persuasion (e.g. *Mash the broccoli and try putting lemon on it*, or *Try putting on a toothpaste you like*) or those statements that exploit the use of one's experience as role model (e.g. *Do you know that I always eat broccoli*?, or *My friend Michele also washes them. When I wash my teeth, he also washes them*). In addition to Peterson and colleagues' (2018) coding, we annotated the presence of metaphors in the answers (e.g., *Broccoli is candy*), which resulted in a metaphor count measure. To confirm the inter-rater reliability of the persuasion test adapted in Italian, two authors (CP, ED) independently coded 20% of the data, and the agreement between raters was determined with the interclass correlation coefficient (ICC). The ICC was calculated on a mean-rating (k = 2), average-agreement, 2-way mixed-effects model, and values were reported along standard guidelines (Koo & Li, 2016). The average agreement for each strategy of the coding procedure was overall excellent: Negative: *ICC* = 1, *95% CI* [1, 1], $p < .001$; Positive: *ICC* = .99, *95% CI* [.99, 1], $p < .001$; Psychological: *ICC* = .99, *95% CI* [.99, .99], $p < .001$.

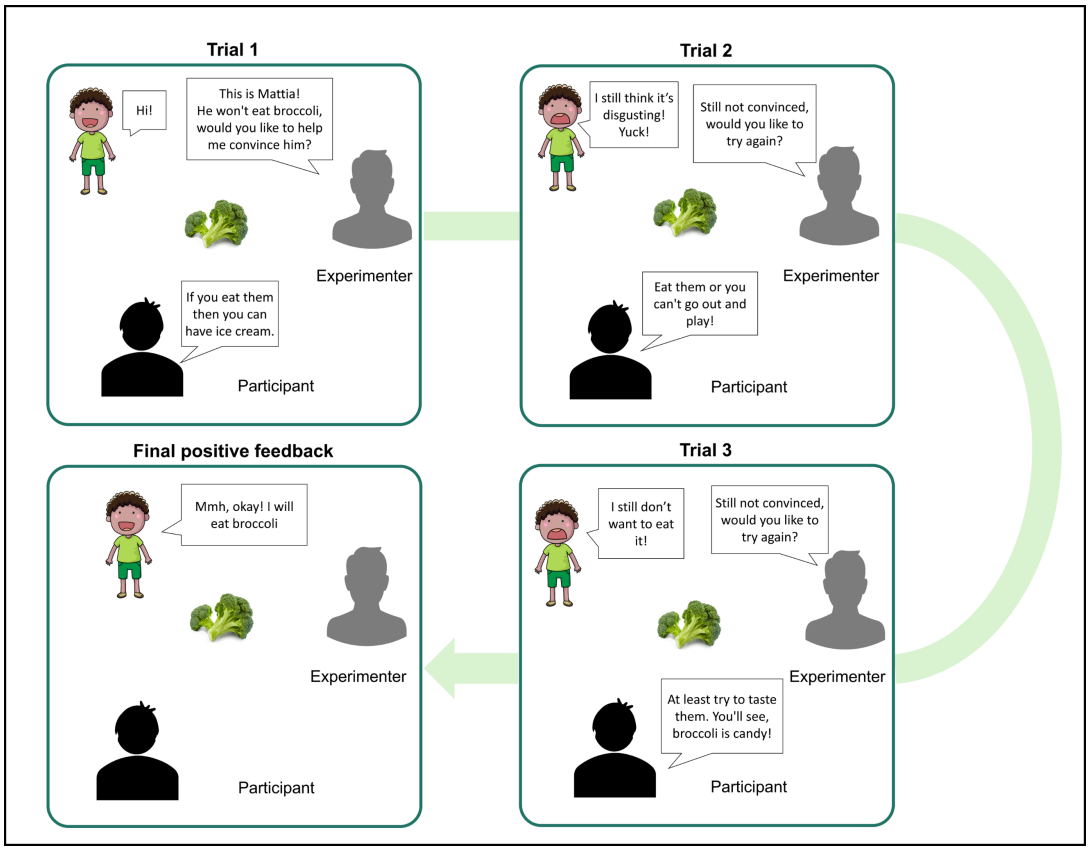

Figure 1. Schematic representation of the Persuasion task adapted from Peterson and colleagues (2018). Examples are offered in English translation from Italian.

Statistical Analysis

As a preliminary step, after computing Pearson's correlations between all variables, we checked the developmental effects on all linguistic and cognitive covariates via linear models (with dependent variables being Vocabulary, Working Memory, and Metaphor Comprehension and Production).

As for the main analysis, its purpose was to assess a) the development of persuasive abilities considering the use of different persuasive strategies (Negative, Positive, and Psychological); and b) the role of metaphor skills in persuasion, also controlling for linguistic and cognitive abilities. In line with the literature about pragmatic development (e.g., Köder & Falkum, 2020), developmental stages were studied by considering three age groups (i.e., 4-, 5-, and 6-year children): this strategy allowed us to straightforwardly capture non-monotonic effects across ages, without imposing any a priori assumptions about the functional form (e.g., linear, quadratic, cubic, etc.) of an age

gradient (Stone et al., 2010). To meet our goals, and in light of our research questions and hypotheses, we fitted a Generalized Linear Mixed-effect Model (GLMM) testing for the difference between Age Groups (effect coded in a backward sequential way: 5 vs. 4; 6 vs. 5) in interaction with the Type of persuasive strategy (effect coded in a backward sequential way: positive vs. negative; psychological vs. positive) and scaled individual differences in linguistic and cognitive variables (Vocabulary, Working Memory, and Metaphor Comprehension and Production). We fixed model parameters to follow a Poisson distribution, with a log link function. For considering the variability at the individual (Subject) and Item level, we included the relevant random structures to account for participants' and materials' grouping factors. Moreover, we added the term accounting for repeated assessment within items (Trial) in the random part. The model's formula was: Persuasion scores ~ Age group * Type * (Vocabulary + Working Memory + Metaphor Comprehension + Metaphor Production) + (1|Subject) + (1|Items) + (1|Trial). We also measured the proportion of Metaphors in children's persuasive statements via a separate linear regression model, whose formula was: Metaphor count ~ Age group.

After fitting each mixed-effect model, we checked model assumptions with the diagnostic inspection tools included in the DHARMa package (v. 0.4.7; Hartig, 2024). In both models, the diagnostics were satisfactory (see also the additional materials provided in the OSF repository). Differences between factors, simple effects (i.e., slopes) of individual measures, and differences between slopes (i.e., interactions) are reported as Odds Ratios (OR; with their 95% Confidence Interval). The significance of fixed effects (i.e., the associated *p*-values) in each generalized mixed model was calculated with the approximation-based approach (for further details, see Kuznetsova et al., 2017). To detail differences between levels of the categorical predictors in a pairwise fashion, we conducted post-hoc analysis on age-related and type-related effects, and the statistical significance of differences was Tukey-adjusted. All statistical analyses were performed in R (v. 4.2.3; R Core Team, 2023), with the R Studio editor (v. 2023.09.1+494), using the *lme4* (v1.1-26; Bates et al., 2015), the *lmerTest* (v. 3.1-3; Kuznetsova et al., 2017), and the *emmeans* (v. 1.10.6-090001; Lenth, 2024) packages.

Results

Children's performance in each variable, across Age Groups, is shown in Table 1 and graphically represented in Figure 2.

Table 1. ***Descriptive statistics of children's performance in each age group.***

Measures	Range of possible scores	Full sample (N = 167) *M* (*SD*)	4 years (*n* = 52) *M* (*SD*)	5 years (*n* = 76) *M* (*SD*)	6 years (*n* = 39) *M* (*SD*)
Vocabulary	0-175	69.4 (24.8)	51.6 (17.7)	70.0 (21.5)	91.7 (19.9)
Working Memory	0-8	2.06 (1.75)	1.06 (1.49)	2.04 (1.69)	3.44 (1.19)
Metaphor Comprehension	0-10	4.38 (1.56)	4.33 (1.42)	4.04 (1.60)	5.15 (1.50)
Metaphor Production	0-8	2.23 (1.97)	1.02 (1.18)	2.07 (1.59)	4.15 (2.05)
Persuasion Total score	0-∞	4.08 (2.63)	2.64 (2.23)	4.33 (2.66)	5.46 (2.21)
Persuasion Positive score	0-∞	1.57 (1.70)	0.72 (1.07)	1.80 (1.60)	2.26 (2.12)
Persuasion Negative score	0-∞	1.10 (1.58)	0.66 (1.20)	1.21 (1.61)	1.44 (1.87)
Persuasion Psychology score	0-∞	1.40 (1.64)	1.25 (1.48)	1.32 (1.59)	1.74 (1.89)
Metaphors count	0-∞	0.14 (0.49)	0.08 (0.27)	0.09 (0.29)	0.33 (0.87)

Note: Cells report the average value along with the standard deviation (in parentheses) for each measure for the whole sample of 167 children and separated for each age group

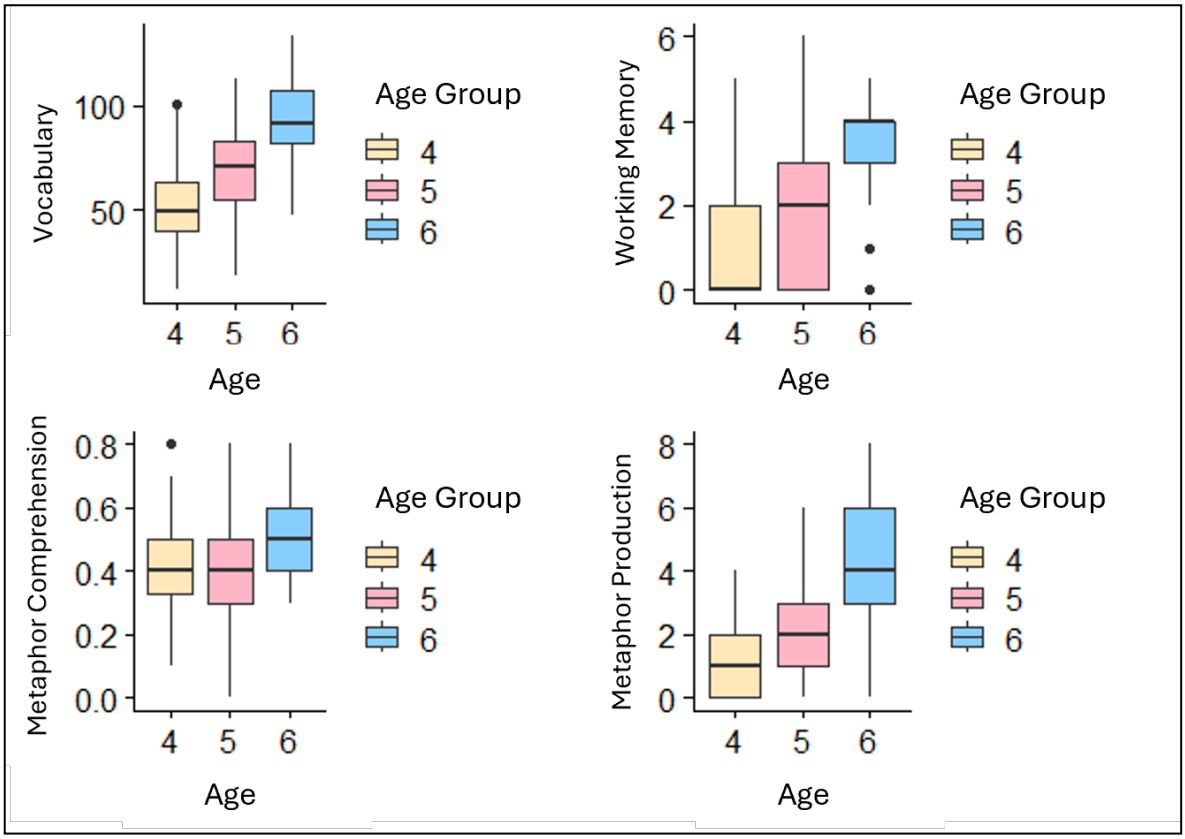

Figure 2. Box plot of the linguistic, cognitive, and socio-cognitive measures for each age group. The central mark indicates the median, the bottom edge the 25th percentile and the top edge the 75th percentile of data. The whiskers indicate 1.5 times the interquartile range.

Pearson's correlation coefficients are plotted in the correlogram in Figure 3. The Total Persuasion score was positively associated with age, as well as with Vocabulary and Metaphor Production. Vocabulary further correlated positively with Positive and Negative persuasion strategies while Working Memory correlated with Positive strategies only. Moreover, Metaphor count was positively correlated with Vocabulary and Psychological persuasion strategies.

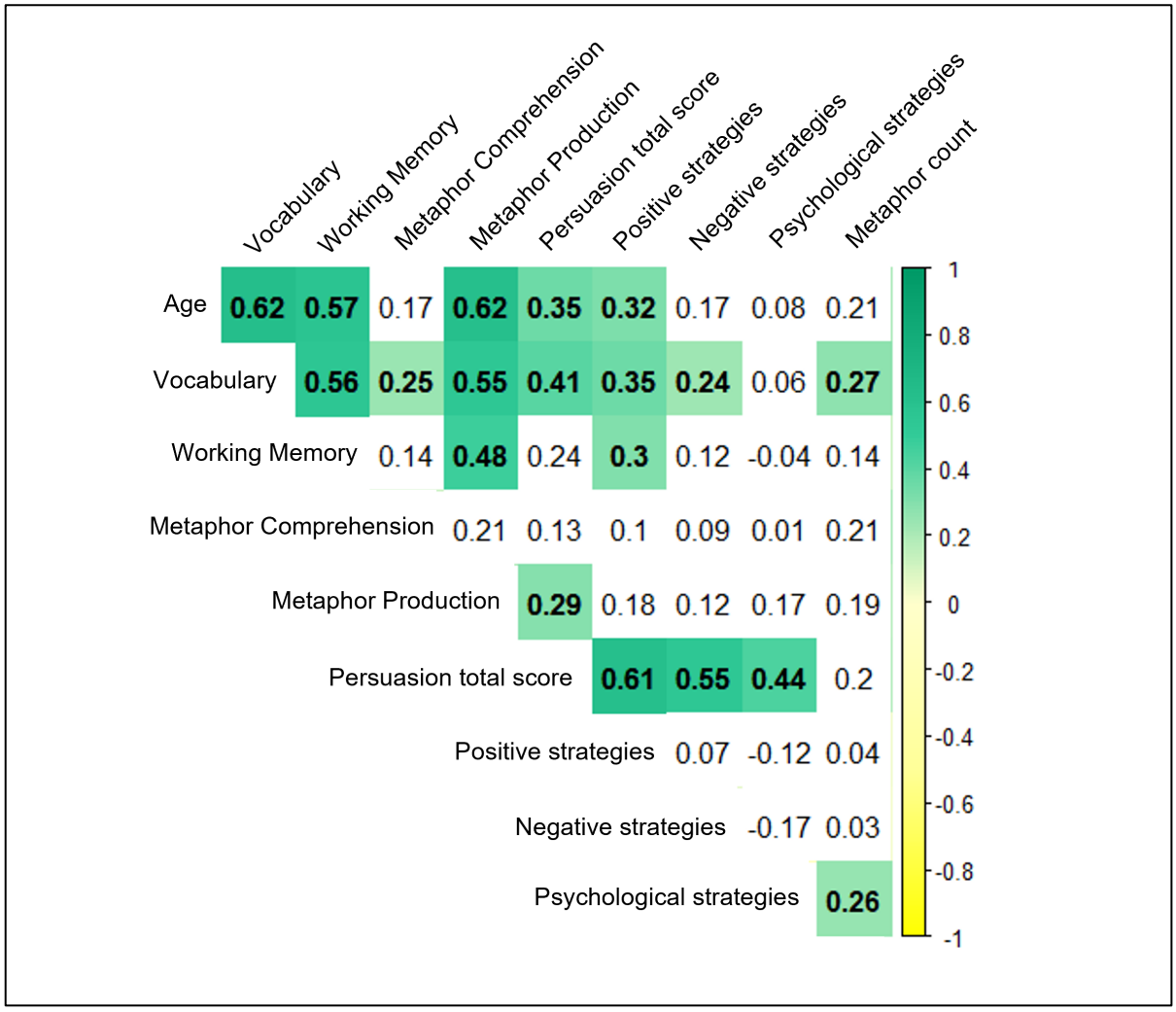

Figure 3. Correlogram between persuasion scores, linguistic and pragmatic variables. The plot shows correlations between Persuasion scores and Vocabulary, Working Memory and Metaphor Comprehension and Production, and Metaphor count. Positive correlations are displayed in green and negative correlations in yellow. The color intensity is proportional to the magnitude of the correlation coefficients. White cells indicate associations at *p*-value > .05. Age was transformed in months.

Developmental effects of linguistic and cognitive covariates

The model on Vocabulary showed a significant effect of Age Group for both the 5 vs. 4 and the 6 vs. 5 comparisons (5 vs. 4: $\beta = 16.67$, $CI = [9.58, 23.76]$, $t = 4.64$, $p < .001$; 6 vs. 5: $\beta = 22.83$, $CI = [14.82, 30.85]$, $t = 5.62$, $p < .001$), showing an increase in verbal

abilities both between the ages of 4 and 5 and between the ages of 5 and 6. The model on Working Memory showed a significant effect of Age Group for both the 5 vs. 4 and the 6 vs. 5 comparisons (5 vs. 4: $\beta = 0.90$, $CI = [0.37, 1.43]$, $t = 3.37$, $p = .001$; 6 vs. 5: $\beta = 1.45$, $CI = [0.85, 2.05]$, $t = 4.79$, $p < .001$), showing an increase in working memory skills both between the ages of 4 and 5 and between the ages of 5 and 6. The model on Metaphor Comprehension showed a significant effect of Age Group for the 6 vs. 5 comparison (6 vs. 5: $\beta = 0.11$, $CI = [0.05, 0.17]$, $t = 3.76$, $p < .001$), showing an increase in metaphor comprehension skills only between 5 and 6 years of age. The model on Metaphor Production showed a significant effect of Age Group for both the 5 vs. 4 and the 6 vs. 5 comparisons (5 vs. 4: $\beta = 1.05$, $CI = [0.49, 1.60]$, $t = 3.72$, $p < .001$; 6 vs. 5: $\beta = 2.09$, $CI = [1.48, 2.70]$, $t = 6.72$, $p < .001$), showing an increase in metaphor production skills both between the ages of 4 and 5 and between the ages of 5 and 6.

Developmental trajectories of persuasive skills and association with cognitive and linguistic covariates

The model on Persuasion scores (see Table 2) showed a significant difference between 4 and 5 years in Persuasion scores (5 vs. 4: $OR = 1.42$, $CI = [1.10, 1.83]$, $z = 2.68$, $p = .007$), with 5-year-old children using more persuasive arguments than 4 years children, and a significant difference between Positive and Negative arguments, (Positive vs. Negative arguments: $OR = 1.36$, $CI = [1.09, 1.69]$, $z = 2.75$, $p = .006$), indicating that children in general used more positive than negative arguments. Moreover, a significant Age Group (5 vs. 4) by Type (Psychological vs. Positive arguments) interaction was observed ($OR = 0.49$, $CI = [0.29, 0.81]$, $z = –2.79$, $p = .005$), with an increase of positive rather than psychological arguments between 4 and 5 years of age (see Figure 4a). When inspecting the pairwise differences between persuasion strategies within age groups, we confirmed that 5-year-olds used to a greater extent positive over negative ($\Delta\beta = 0.39$, $z = 2.79$, $p = .010$) and psychological over positive strategies ($\Delta\beta = –0.30$, $z = –2.23$, $p = .049$). Differently, comparisons in other age groups did not reach statistical significance (4: $\Delta\beta < 0.42$, $p > .096$; 6: $\Delta\beta < 0.46$, $p > .092$).

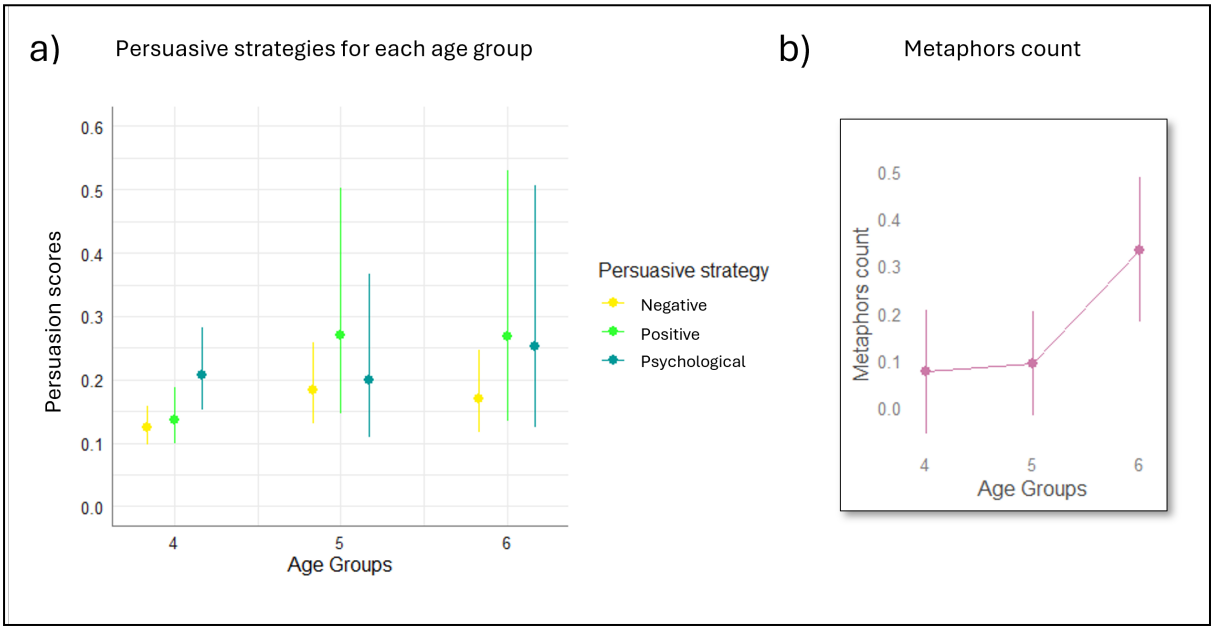

Figure 4. Development of persuasive strategies and focus on the use of metaphors. Panel a) depicts model estimates of the use of different persuasive strategies across Age Groups. Panel b) displays the use of metaphors across different Age Groups. In both panels, error bars represent the standard deviation of model estimates.

Regarding the scaled continuous predictors, the model showed a main effect of Vocabulary (OR = 1.21, CI = [1.06, 1.37], z = 2.88, p = .004): greater vocabulary skills were associated with the use of more persuasive arguments, regardless of the type of strategy (see Figure 5a). The model also highlighted a significant Working Memory by Type (Psychological vs. Positive) interaction (OR = 0.69, CI = [0.55, 0.86], z = –3.23, p = .001): the post-hoc analysis identified that higher levels of working memory were associated with a higher use of positive strategies (β = 0.10, CI = [0.00, 0.19], z = 2.01, p = .045) and a lower use of psychological arguments (β = –0.12, CI = [–0.22, –0.01], z = –2.24, p = .025; see Figure 5b). In addition, a significant Metaphor Production by Type (Psychological vs. Positive arguments: OR = 1.39, CI = [1.12, 1.73], z = 3.00, p = .003) interaction was observed: specifically, the post-hoc analysis revealed that higher abilities to produce metaphors were associated with the use of more psychological arguments compared to positive ones, due to a significant simple effect with psychological strategies (β = 0.12, CI = [0.03, 0.20], z = 2.57, p = .010; see Figure 5c). No effect of Metaphor Comprehension on Persuasion scores was found (see Figure 5d).[1]

[1] We acknowledge the debate about the treatment of the age variable. To allow for comparisons with the current state of the art, we kept in the main text the analysis with the age groups. For the sake of completeness, we replicated our analyses using age as a continuous variable, and, due to potential

Table 2. ***Output of the generalized linear mixed-effects model with the persuasion scores as the dependent variable.***

Fixed effects	*Incidence Rate Ratios*	*CI*	*z-value*	*P value*
(Intercept)	0.19	0.15 – 0.25	–13.20	**< .001**
Age 5 vs. 4	1.42	1.10 – 1.83	2.68	**.007**
Age 6 vs. 5	1.05	0.81 – 1.36	0.35	.728
Positive vs Negative	1.36	1.09 – 1.69	2.75	**.006**
Psychological vs Positive	1.04	0.85 – 1.27	0.39	.697
Vocabulary	1.21	1.06 – 1.37	2.88	**.004**
Working Memory	0.98	0.87 – 1.10	–0.35	.726
Metaphor Comprehension	1.02	0.93 – 1.13	0.51	.612
Metaphor Production	1.03	0.92 – 1.16	0.55	.583
Age 5 vs. 4 × Positive vs Negative	1.35	0.76 – 2.37	1.03	.303
Age 6 vs. 5 × Positive vs Negative	1.08	0.64 – 1.80	0.28	.783
Age 5 vs. 4 × Psychological vs Positive	0.49	0.29 – 0.81	–2.79	**.005**
Age 6 vs. 5 × Psychological vs Positive	1.27	0.77 – 2.09	0.95	.345
Positive vs Negative × Vocabulary	0.94	0.72 – 1.22	–0.48	.630
Psychological vs Positive × Vocabulary	0.80	0.62 – 1.02	–1.82	.069
Positive vs Negative × Working Memory	1.21	0.96 – 1.53	1.60	.110
Psychological vs Positive × Working Memory	0.69	0.55 – 0.86	–3.23	**.001**
Positive vs Negative × Metaphor Comprehension	0.98	0.81 – 1.19	–0.21	.834
Psychological vs Positive × Metaphor Comprehension	0.91	0.76 – 1.10	–0.97	.333
Positive vs Negative × Metaphor Production	0.92	0.73 – 1.16	–0.73	.466
Psychological vs Positive × Metaphor Production	1.39	1.12 – 1.73	3.00	**.003**

Random effects	*Variance*	*SD*
$Intercept_{Subject}$	0.10	0.32
$Intercept_{Trial}$	0.01	0.10
$Intercept_{Item}$	0.02	0.14
$ICC_{SubjectTrialItem}$	0.07	

Model fit	*Marginal*	*Conditional*
R^2	.094	.159

collinearity with vocabulary measures, which is highly correlated (r = .62) in our sample, we cautiously fit a model with age only. The model with continuous age replicated the effects of the original (i.e., with age groups) for all predictors. Furthermore, it coherently reported a significant effect of scaled age in predicting a greater use of persuasive arguments.

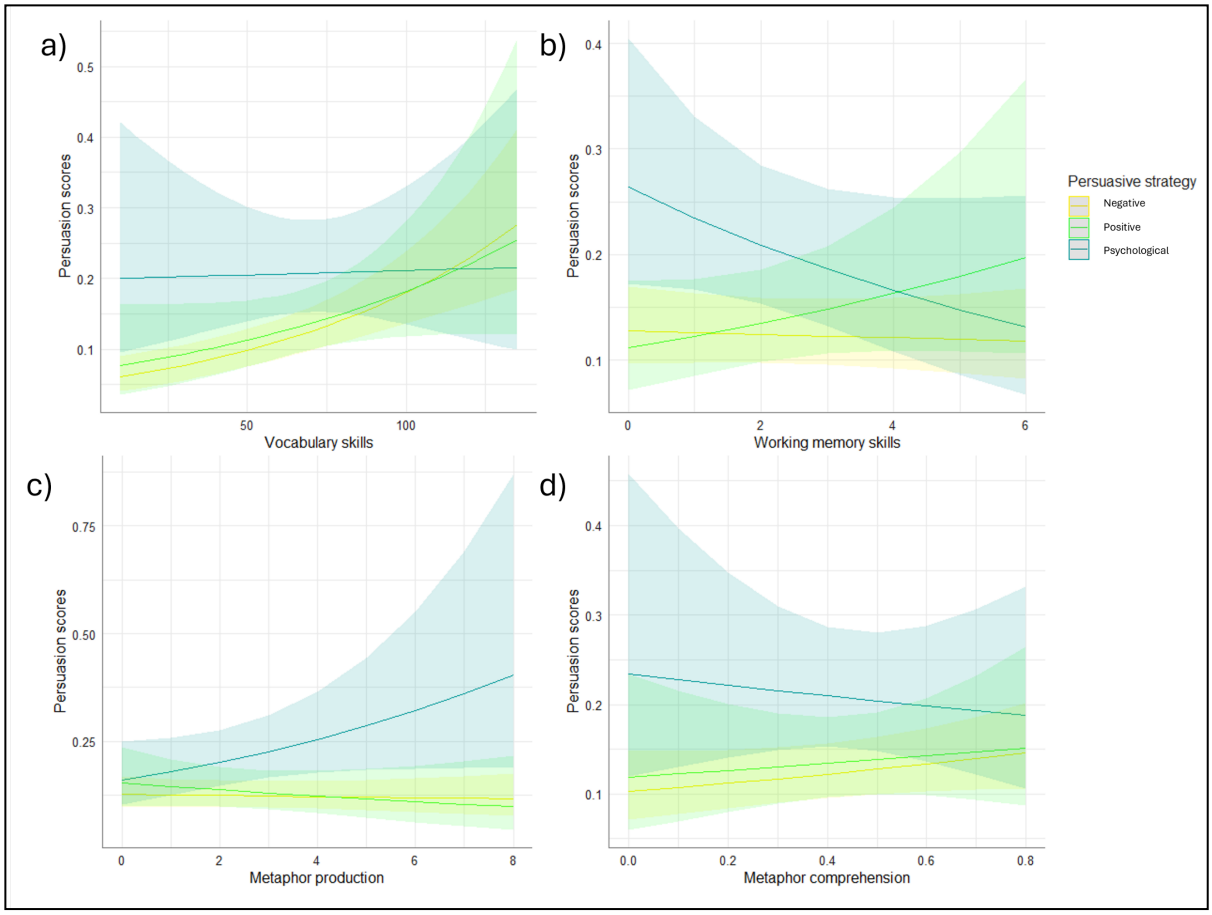

Figure 5. Association between persuasive strategies and covariates. The plot reports the relationships between persuasive strategies (Negative, Positive, Psychological) and Vocabulary (Panel a), Working Memory (Panel b), Metaphor production (Panel c), and Metaphor comprehension (Panel d).

The model on Metaphor count (see Table 3) showed a significant effect of Age Group for the 6 vs. 5 comparison showing that children's use of metaphors increased between 5 and 6 years of age ($\beta = 0.24$, $CI = [0.05, 0.43]$, $t = 2.53$, $p = .012$; see Figure 4b).

Table 3. ***Output of the linear model with the metaphor count as the dependent variable.***

Predictors	*Estimates*	*CI*	*z-value*	*p-value*
(Intercept)	0.17	0.09 – 0.24	4.31	**< .001**
5 vs. 4	0.02	–0.15 – 0.19	0.19	.848
6 vs. 5	0.24	0.05 – 0.43	2.53	**.012**
Model Fit	*Marginal*	*Marginal*		
R^2	.046	.034		

Discussion

The main goal of this study was to explore the long-standing yet empirically under-investigated hypothesis that metaphor and persuasion skills are intertwined, with a focus on typically developing children in early childhood. The results confirmed our hypothesis, showing an effect of expressive metaphoric skills, even controlling for general language skills, in promoting specifically the use of high-level psychological persuasive strategies, involving mitigation and modeling, in early childhood. Before discussing this issue, we will comment on the data regarding the age-related changes in persuasive skills.

Our results showed a significant increase in persuasion performance between 4 and 5 years of age. This finding fits with previously reported data on the development of persuasive skills using observational measures (Bartsch et al., 2011) and offers more stringent evidence based on a controlled experimental task. Moreover, while previous studies described a linear pattern of development from age 3 to adolescence (Slaughter, Peterson, & Moore, 2013; Peterson et al., 2018), our data showed that the age of 5 years constitutes a turning point for persuasive skills. Interestingly, in this developmental phase, children develop one of the key components of critical thinking, namely they become able to distinguish between strong and weak reasons and to revise their beliefs when they learn that the underlying reasons were invalid (Schleihauf et al., 2022). This suggests that the capacity to evaluate how well reasons speak for or against a given belief might go hand in hand with the ability to build persuasive arguments.

What drives the improvement in persuasion performance seems to be, in particular, the use of positive persuasive strategies, which are cornerstones of persuasive arguments even at six years of age. In line with previous studies (Slaughter, Peterson, & Moore, 2013), we observed that children preferred positive strategies (i.e., proposing

a reward) over negative ones (i.e., implying penalties to avoid noncompliance), regardless of age. We speculate that this type of preference may depend on parenting style, which was shown to play a strong role in children's communicative skills. At present, the authoritative style (i.e., controlling and demanding style, encouraging verbal give and take, and sharing with the child the reasoning behind parents' policy, see Lavrič & Naterer, 2020) is the most widely used in Western societies (Yaffe, 2023). The use of more positive strategies in our sample might reflect the modern transition from the authoritarian style (i.e., relying on control and sanctions) to the authoritative one, encouraging communicative exchanges that are based on reciprocity, positively connoted, and less based on punishment (Estlein, 2021; Wilson et al., 2012). For what concerns psychological strategies, we do not observe a general increase in their use of these strategies in our sample. Indeed, a more varied use of persuasive strategies, including psychological ones, is observed later in development, particularly in middle childhood (Lonigro et al., 2017).

Although high-level persuasive strategies do not significantly increase in early childhood, our study highlights individual differences in their use. Specifically, metaphor production skills predicted the use of psychological strategies, with children better at metaphor production also being better at using psychological tools to build persuasive arguments. At a general level, this finding is compatible with previous evidence that high-level language skills favor the development of persuasive skills in adolescents (Nippold et al., 2005). More specifically, the effect of metaphor production on psychological strategies can be explained in light of its role in shaping cognitive and conceptual operations. Either via embodied simulation (as argued by cognitive linguistics theories) or via semantic associations (as suggested by the analogy account), metaphor promotes thinking processes (Holyoak & Stamenkovíc, 2018). Such thinking activity, either propositional or not, is deemed key to understanding and mastering persuasive argumentation. In particular, a metaphor might promote a mental simulation of the concept described metaphorically (Canal et al., 2022), engaging image-based processes that enhance the persuasive capacity (Sopory & Dillard, 2002a). In addition, compared to a literal expression, a metaphor increases the connections and inferences drawn for a given concept (Zhu & Gopnik, 2023), generating also a greater number of thoughts connected with the message advocacy and ultimately amplifying the persuasive power (Sopory & Dillard, 2002a). In this light, higher expressive metaphorical skills might provide children with a sophisticated toolkit for a deeper conceptualization of the topic and the implementation of effective argumentation. While our data do not allow us to discriminate between embodied and semantic mechanisms of metaphorical thinking, it is possible that the two dimensions coexist and further strengthen the link between expressive metaphor skills and persuasion. For instance, children might transfer a rich set of inferences about a concept

(Zhu & Gopnik, 2023) to shape informative persuasive arguments (Mazzarella & Vaccargiu, 2024; Rossi & Macagno, 2021) and exploit for the same purpose the images and sensorimotor experience evoked by the metaphor.

Another possible link between metaphor expressive skills and persuasive skills, partly connected to the cognitive elaboration views proposed above, deals with the emotional evaluation of concepts. In promoting a deeper conceptualization, metaphor also leads to a greater evaluation of the concepts in terms of valence associated with their attributes (Fainsilber & Ortony, 1987). The greater number of valenced thoughts might, when they are in the appropriate direction, in turn, promote persuasion. Recently, a training study on both metaphors and climate change, revealed that children not only improved in their knowledge on the topic, but the training also modulated their psychological and emotional attitudes (Hope and Despair), thus enhancing their pro-environmental behavior compared to their peers who undergo the same training on climate change without the use of metaphors (Pompei et al., 2024). This evidence suggests a deep connection between metaphors and emotional, psychological, and behavioral transitions, which are core dimensions of persuasion implementation (Sbisà, 2013).

Finally, the interplay between expressive metaphorical skills and persuasion might be related to the variety of social functions served by metaphors, even in children. Expressive metaphorical skills allow children to negotiate meaning within the communicative exchange, as it occurs during learning when pupils dynamically modify their metaphorical productions during collaborative meaning-making (Deignan & Semino, 2022). Moreover, metaphorical communication may increase the level of intimacy between interlocutors, as Bowes and Katz showed (2015), and these positive effects on social relationships are already manifest in children (Del Sette et al., 2021). As soon as children start to build their expressive metaphor competence, they may draw on these abilities, ensuring reciprocity in communication, greater intimacy with the interlocutor, and the creation of a shared communicative background.

The analysis of the use of metaphorical expressions during children's persuasive attempts makes the link between expressive metaphorical skills and persuasion skills even more striking. Older children were able to actively use metaphorical expressions to implement sophisticated psychological persuasive attempts. Specifically, older children used expressions such as *Broccoli is candy*, or *Brushing your teeth makes you shiny*, in 2.7% of the total persuasive attempts. Whereas for positive statements, such as *Broccoli makes you grow up*, the child must retrieve their semantic knowledge about the topic (i.e., broccoli's well-known positive effects on growth) through close associations (i.e., *broccoli-growth*), in the case of metaphorical statements, the child needs

to exploit more distant associations (i.e., *broccoli-candy*) (Kintsch, 2000; Wojcik & Kandhadai, 2020). In this view, the paradigmatic association *broccoli-candy* may modify the psychological attitude of the persuadee, bridging the semantic distance between the two terms by capitalizing on the common experience of the sweetness of candies. Moreover, following the embodied account (Gibbs, 2006), the use of a metaphor may activate multimodal semantic processing, exploiting the imagery involved in metaphor understanding (Canal et al., 2022), making, for instance, the persuadee experiences the positively valenced sweetness of a candy. This may directly increase the sensorial experience and the valence related to the argument, thus boosting the persuasive effect via cognitive and affective processes (Dillard & Seo, 2012; Seo et al., 2013). Also, the use of metaphors may increase the level of connection between the two interlocutors (Colston & Rasse, 2022), fostering higher levels of social connectedness that can enhance persuasive effects (Gass & Seiter, 2022). Through the use of metaphor, hence, children generate a cognitive multiplication of interpretive spaces (Baldi, 2020), maximizing persuasive effects by activating cognitive, affective, and social channels to access to the interlocutor's representation of the topic.

While metaphor production skills were key, we didn't observe a significant effect of receptive metaphorical skills on high-level persuasive strategies or other types. A possible explanation for this result might have to do with the slow maturation of metaphor comprehension skills, at odds with expressive abilities. While there is evidence that children are good producers of metaphors very early on (Gardner et al., 1975; Vosniadou, 1987), for comprehension, young children are able to perform certain metaphor tasks (Pouscoulous & Tomasello, 2020), but their ability to fully articulate metaphorical meaning is still fragile until late childhood (Del Sette et al., 2020; Lecce et al., 2019; Winner et al., 1976). According to this perspective, metaphor comprehension and production abilities may follow diverse developmental trajectories, thus enriching communicative competence in different moments and to different extents. We argue that receptive metaphor skills might equip the child with additional social competencies for persuasive purposes at later stages, possibly in middle childhood, in parallel with the flourishing of sophisticated mind-reading skills and the effect of metaphor on fostering peer relationships (Del Sette et al., 2021). Besides metaphor skills, our data confirmed the role of general linguistic skills in supporting persuasion abilities across strategies, in line with Nippold et al. (2005). However, by looking at the correlations, positive and negative strategies were positively associated with vocabulary skills (as suggested also by the inspection of Figure 5), while psychological ones were not. This suggests that, while children might rely on their linguistic repertoire to produce positive and negative strategies, this is not sufficient to achieve complex psychological arguments. Working memory skills, conversely, hinder the production of psychological strategies. Previous studies showed that individuals with

high working memory tend to persist in using complex, attention-demanding approaches, even when those are suboptimal for task demand (DeCaro et al., 2016). Specifically, generating psychological persuasive strategies involves high-level cognitive and communicative tasks, which cannot be supported by executive functions alone, and capitalizing excessively on working memory in a pragmatic task might result in a drop in performance.

While this study provides information on the unexplored link between metaphors and persuasion in development, it has some limitations. Firstly, we did not account for possible mediating effects of ToM, which is strongly involved in persuasive skills in childhood (Lonigro et al., 2017; Peterson et al., 2018) and has a crucial role in the development of pragmatic skills more broadly (Del Sette et al., 2020; Lecce et al., 2019; Petit et al., 2025; Tonini et al., 2023). Secondly, our task consisted of only two items, which, besides being limited in number, involved the conversation with a peer (while children may use different strategies when persuading adults, Lonigro et al., 2017) and were based on requests that did not involve the child's actual desire. Future studies may include ToM measures and map socio-communicative abilities in a wider range of tasks, also modulating variables such as the age of the interlocutor and the child's motivation within the persuasive context. Furthermore, although we believe that the metaphor production effects on psychological persuasion are genuine, emerging specifically for psychological strategies, we cannot rule out the possibility that this association is due to the shared expressive modality of both tasks. Further studies using other non-metaphorical productive tasks could help determine whether this effect is driven solely by modality compatibility or if a true association exists between the two abilities at stake.

The link between persuasion and metaphor operates on multiple levels: on the pragmatic level, metaphor constitutes a tool that enables sharing common ground in terms of meanings and experiences; on the cognitive level, metaphor strengthens the ability to find persuasive arguments; in addition, metaphor operates on social connections, enabling increased levels of intimacy between conversational partners. Both phenomena operate on these three levels; at the same time, their connection cannot but hold a multifaceted nature.

Albeit not conclusive, our results offer first insights into the relevance of metaphorical skills, particularly expressive ones, during early childhood, for communicative and social purposes. Children develop their persuasive skills early on, to begin actively signing their *contract* with the world. At the age of 5, children begin to formulate their first complex requests and do so using strategies based on reward or focusing on the positive outcomes of their proposals, preferring them over strategies based on

punishment or threats of negative outcomes. Only a few children, however, attempt a psychological approach to the interlocutor during early childhood, creating a channel for changing attitudes, not just behavior, toward the topic. Children who adopt these high-level strategies are those who start enriching their communicative repertoire, pivoting around metaphors as powerful tools for thinking and navigating the social world.

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Data, Code, and Materials Availability Statement

The dataset analyzed in the study and the code for the analysis are available in the Open Science Framework repository at the link: https://osf.io/85zu4/?view_only=90088190e23941e1806d91cbb7a6b041

Materials cleared for open access (the metaphor production task and the persuasion task) are available in the Open Science Framework repository at the link: https://osf.io/85zu4/?view_only=90088190e23941e1806d91cbb7a6b041.

Content subject to commercial licensing agreements (e.g., the PPVT-R and the word recall task) is not included among the publicly accessible resources. For the metaphor comprehension task, only the textual components of the items are provided, as licensing considerations are currently under evaluation. In the latter case, complete task materials can be obtained upon reasonable request from the corresponding author.

Ethics Statement

Ethics approval was obtained from the Local Ethical Committee of the Department of Brain and Behavioral Sciences of the University of Pavia (protocol n. 029/2019), following the principles of the Declaration of Helsinki. Both parents of each participant gave informed written consent before taking part in the study.

Authorship and Contributorship Statement

Chiara Pompei: Investigation, Data Curation, Methodology, Formal Analysis, Visualization, Writing – original draft; **Serena Lecce**: Conceptualization, Methodology, Supervision, Writing – review and editing; **Paola Del Sette**: Investigation, Data curation, Writing – review and editing; **Elena Didoni**: Data Curation, Writing – review and editing; **Luca Bischetti**: Formal Analysis, Writing – review and editing; **Valentina Bambini**: Conceptualization, Methodology, Supervision, Writing – review and editing.

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