Metaphor comprehension in preschool children: Individual differences and metaphor-related factors affecting metaphor comprehension

Pelin Küçükerdoğan
Deniz Tahiroglu
Boğaziçi University, Turkey

Abstract: Metaphor comprehension in children has been a topic of interest for decades. Contrary to the previous belief that metaphor comprehension emerges at the formal operational stage, recent findings suggest that preschool children can also comprehend metaphors when the metalinguistic demands are controlled. However, these studies have primarily focused on children's physical metaphor comprehension, with only a few investigating psychological metaphor comprehension and the factors that influence this process. This study addresses this gap by presenting stories containing psychological metaphors to 62 Turkish-speaking preschool children. Participants were asked to identify the emotion of the character in the story (revealed in the metaphoric phrase only) by selecting the correct picture. Effects of individual differences in cognitive abilities (cognitive flexibility skills, pretend play, and language complexity) and metaphor-related factors (context and familiarity) were also investigated. Overall, children were more likely to choose the picture depicting the correct emotion compared to the distractors and incorrect pictures. A positive relationship was found between cognitive flexibility and metaphor comprehension; however, no correlation was observed between metaphor comprehension and either pretend play or language complexity. Contrary to our expectations, context and familiarity with the metaphors did not significantly affect metaphor comprehension. However, a marginal interaction between cognitive flexibility and metaphor familiarity suggested that cognitive flexibility might be especially important for understanding less familiar metaphors. Generally, the current study replicated and extended the findings, suggesting that preschool children have some understanding of psychological metaphors and emphasized the importance of simultaneously investigating the effects of cognitive and metaphor-related factors.

Keywords: metaphor comprehension; psychological metaphors; cognitive flexibility; pretend play; language complexity

Corresponding author: Pelin Küçükerdoğan, Department of Psychology, Boğaziçi University. Email: pelinckrdgn@gmail.com

ORCID ID(s): Pelin Küçükerdoğan: https://orcid.org/0009-0008-3984-5939; Deniz Tahiroglu: https://orcid.org/0000-0003-3871-8811

Introduction

The development of figurative language comprehension, particularly metaphor comprehension, is crucial for linguistic and cognitive growth in children. Metaphors are prevalent in daily communication, storybooks, and cartoons (e.g., Marriott, 2002; McCrindle & Odendaal, 1994; Taggart et al., 2019). They are utilized to express complex ideas, emotions, and abstract concepts (Vosniadou, 1987). Therefore, understanding how children acquire and comprehend metaphors can provide valuable insights into their cognitive development and linguistic capabilities.

Although children's metaphor comprehension has received substantial attention, a dispute persists regarding how well they understand and learn from metaphorical expressions. The literature presents conflicting findings concerning the extent to which children possess a solid understanding of metaphorical phrases at an early age. While previous investigations by Piaget (1926), Asch and Nerlove (1960) and Winner et al. (1976) suggest that children under the age of 10 struggle to understand metaphors, more recent studies by Deamer (2013), Pouscoulous and Tomasello (2020) and Özçalışkan (2005) indicate that younger children do possess some degree of metaphor comprehension when tested with age-appropriate tasks and with physical metaphors (e.g., "tower with a hat" implying the roof over the tower). These recent studies provide evidence for early metaphor comprehension and highlight the role of age-appropriate assessment methods. Extending this line of inquiry, we also consider it important to investigate psychological metaphor comprehension specifically (e.g., "shining like the sun" implying happiness), as well as cognitive and metaphor-related factors that may influence the comprehension process in preschool children. Psychological metaphor comprehension is a critical area of inquiry, as it holds potential implications for both abstract language development and practical applications in the clinical field. For instance, facilitating the acquisition of psychological metaphor comprehension may enhance children's ability to recognize and express emotions, thereby contributing to more effective therapeutic interventions and improved emotional well-being.

Therefore, in the current study, we attempt to assess preschool children's psychological metaphor comprehension abilities in relation to both individual differences in cognitive abilities (e.g., executive function skills) and metaphor-related factors (e.g., context and familiarity). First of all, we present the theoretical concept of metaphors and discuss existing theories in regards to children's understanding of metaphors. Further on, we discuss the potential impact of cognitive abilities and metaphor-related factors on the metaphor comprehension process, with a focus on psychological metaphor comprehension.

Theoretical Definition of Metaphors

According to the Conceptual Metaphor Theory (Lakoff & Johnson, 1980), metaphors are composed of a vehicle concept (base) and a topic concept (target). In a metaphorical expression, the role of the vehicle is utilized to reshape our understanding of the topic in an abstract fashion. Namely, the expression "lion-hearted kid" implies that the topic 'kid' bears a resemblance to a 'lion', which serves as the vehicle in this scenario, in terms of the bravery and power lions possess.

The nature of the relationship between the vehicle and the topic has received various interpretations from different accounts. For instance, Gentner (1983) proposes the Structure Mapping Theory, in which she claims that the metaphor comprehension process involves a structural mapping between the vehicle and topic based on their shared features. In other words, this account suggests a comparison between two concepts, focusing on their similarities. Hence, according to the comparison account, "the kid" is similar to "a lion" because they are both brave.

In another line of research, Glucksberg and Keysar (1990) claim that in a metaphorical phrase, the topic is assigned to the category of the vehicle by abstraction. Thus, the key idea of the class inclusion (categorization) account is that metaphors are not merely comparisons, but rather statements of category inclusion, where the topic is considered a member of the superordinate category represented by the vehicle. According to this account, "the kid" is in the same category as "a lion," because both are characterized by bravery. In yet another account, the Career of the Metaphor Theory, Bowdle and Gentner (2005) suggest that whether the relationship between vehicle and topic is based on comparison or categorization depends on the conventionality of the metaphor (also see Blank, 1988; Giora, 1997; Turner & Katz, 1997 for similar approaches). To be more specific, they suggest that novel metaphors are more likely to be perceived as comparisons, while conventional metaphors (ones that have become widely recognized over time) are more likely to be perceived as categorizations.

Although these accounts differ on the exact nature of the relationship between the vehicle and the topic, they all suggest a level of abstraction based on shared attributes of the two concepts. Given these characteristics of metaphors, researchers propose that metaphors play a fundamental role in shaping how we understand and conceptualize the world (Lakoff & Johnson, 1980; Vosniadou, 1987). Thus, they serve a meaning-forming function, particularly in relation to novel or abstract concepts. It is argued that metaphors shape how we think, allowing us to grasp complex and abstract ideas by relating them to more familiar, concrete experiences. For example, we often understand time in terms of physical entities or actions ('time is money' or 'time flies'), which helps make the intangible concept of time more comprehensible through everyday experiences. Additionally, metaphors may be especially valuable for fostering

emotion comprehension (Fainsilber & Ortony, 1987; Fetterman et al., 2016; Kovecses, 1988, 2000). For instance, in a study emphasizing how metaphors can be effective in emotion regulation, Fetterman et al. (2016) found that people experience less negative affect when instructed to articulate their negative memories using metaphorical language, compared to recalling them without any additional prompt, implying an emotion-regulating function of metaphorical language. These findings indicate that metaphors may play a significant role in the context of emotions.

Research examining the role of metaphors in this particular way has primarily focused on adults. However, understanding whether this function of meaning-forming in the context of emotions also holds for children is important, since children have fewer tools than adults to understand and express their emotions (Chronaki et al., 2015). Therefore, identifying additional mechanisms that might enhance children's emotional understanding could be helpful. Nevertheless, before investigating whether children can utilize metaphors to gain a better understanding of their own and others' emotions in further research, it is necessary, as a first step, to address whether young children can understand metaphors that conceptualize psychological states.

Children's Metaphor Comprehension

Earlier accounts of children's metaphor understanding propose that children under the age of 10-12 struggle to understand the abstract connection between the vehicle and topic in a metaphorical expression (Cometa & Eson, 1978; Piaget, 1926; Smith, 1976). Consistent with this perspective, Asch and Nerlove (1960) provided evidence that children must have reached the formal operational stage to effectively articulate the abstract connection between the topic and vehicle in a metaphorical expression.

However, these initial investigations were criticized for relying solely on children's capacity to explicitly verbalize the meaning of metaphors and treating performance scores as definitive proof of metaphor comprehension (e.g., Deamer, 2013; Özçalışkan, 2005; Pouscoulous, 2014, 2023; Pouscoulous & Tomasello, 2020; also see Gardner, 1974; Gentner, 1977; Pearson, 1990; Waggoner et al., 1985). Verbally explaining metaphors involves meta-linguistic abilities and the capacity to engage in discussion about language itself, which differs from understanding metaphorical phrases (Vosniadou, 1987). In other words, one can understand the meaning of a metaphorical phrase but fail when trying to articulate the reason, due to the lack of meta-linguistic skills. With this criticism in mind, recent studies on metaphor comprehension have employed alternative methods that are not limited to verbal responses (e.g., Deamer, 2013; Pouscoulous & Tomasello, 2020; Waggoner & Palermo, 1989; Zhu & Gopnik, 2023). These studies recognize that poor performance on earlier metaphor comprehension tasks may be attributed to younger children's limited meta-linguistic abilities

rather than insufficient comprehension. For example, Pouscoulous and Tomasello (2020) conducted an experiment in which the experimenter described the toys using metaphorical phrases, such as "the tower with a hat" (referring to the roof) and asked 3-year-olds to choose the correct toy from two possibilities. The children in the test group (receiving metaphorical instruction) performed above chance levels and demonstrated a preference for the metaphorically correct item compared to the control group, which was not given a definition and was simply asked to select one of the toys.

The majority of recent research focuses on physical metaphor comprehension, and there are only a few studies addressing psychological metaphor comprehension (e.g., Lecce et al., 2019; Nippold et al., 1984). In such a study by Waggoner and Palermo (1989), participants of various ages, including 5-, 7-, 9-year-olds, and college students, listened to ambiguous stories in which the emotional state of the protagonist was revealed only at the end through a metaphorical expression (e.g., 'Betty was a bouncing bubble'). This phrase served as the final sentence of the story, followed by a question offering two verbal options for the protagonist's emotion (e.g., 'Was she happy or sad?'). The findings provided evidence that even 5-year-olds could choose the accurate emotion for the protagonist above chance levels and that metaphor comprehension increased with age.

While this study significantly contributes to our understanding of the psychological metaphor comprehension abilities of children across different age groups, it presents a limitation that warrants further investigation. In that study, the children were asked to choose between options where one showed a positive emotion and the other showed a negative emotion; thus, the design did not allow for distinguishing whether they understood the general valence of the metaphorical phrase or grasped the specific emotion the metaphor conveyed, which is important for understanding the nuanced process of children's emotional understanding. In the current research, we aim to address this gap. In addition to assessing preschool children's comprehension of psychological metaphors, we also aim to examine whether their cognitive abilities and metaphor-related factors are correlated with their psychological metaphor comprehension.

Cognitive Factors

Metaphor comprehension is believed to be a cognitive and linguistic skill (Özçalışkan, 2005; Vosniadou, 1987). However, existing research lacks a comprehensive discussion of how individual variations in cognitive and linguistic abilities impact metaphorical understanding. This is exemplified by studies that involve different age groups, the results of which consistently show that metaphorical understanding ability increases

with age (ages 5 to 12), implying that cognitive abilities enabling metaphorical understanding unfold over time (Asch & Nerlove, 1960; Waggoner & Palermo, 1989; Winner et al., 1976). Nevertheless, it has not been systematically investigated which cognitive abilities facilitate the process. In this study, we intend to investigate how executive function (EF) skills, the tendency to engage in pretend play, and complex language use might relate to metaphor comprehension in preschoolers.

Executive function (EF) skills are higher-order cognitive capacities with three commonly acknowledged subcomponents: inhibition, cognitive flexibility, and working memory (see Miyake et al., 2000; Spiegel et al., 2021). We propose that out of these three, cognitive flexibility, which involves the ability to adapt and shift perspective based on new information, particularly plays a significant role in metaphor comprehension. According to fundamental metaphor theories (Gentner, 1983; Glucksberg & Keysar, 1990; Lakoff & Johnson, 1980), understanding a metaphor involves inhibiting the literal meaning of the topic and using structural mapping to transfer shared features from the vehicle to the topic. This process also requires a mental shift from literal to figurative language, which inherently demands a degree of cognitive flexibility.

There are a few studies that have already explored the relationship between EF skills and metaphor comprehension. For example, Deamer (2013) found a positive relationship between inhibitory control and physical metaphor comprehension in preschool children. Meanwhile, Carriedo et al (2016) did not find a prevailing impact of EF skills on physical metaphor comprehension in a sample of older children (aged 10-15), yet they did observe that EF skills had a positive influence on understanding more challenging metaphors. These studies provide valuable insights; however, the present research is novel in that it focuses on preschool children and their comprehension of psychological metaphors. This focus is crucial for several reasons. First, the relationship between EF skills and metaphor comprehension may differ from that observed in older children due to the gradual development of EF abilities (Miyake et al., 2000). Furthermore, in the present study, we chose to narrow our focus to study cognitive flexibility specifically, rather than inhibitory control, because the ability to shift between different perspectives or representations may be important for interpreting abstract, psychological metaphorical expressions. While inhibitory control may assist in suppressing literal interpretations, cognitive flexibility can be particularly relevant for psychological metaphors, which often require the child to go beyond surface-level features and integrate multiple mental representations. This is supported by findings suggesting that more abstract metaphors pose greater cognitive demands (Waggoner & Palermo, 1989). Therefore, we anticipate a positive relationship between cognitive flexibility and the comprehension of psychological metaphors in this age group.

Another cognitive factor we examine in the current study is children's tendency to

engage in pretend play. During pretend play, children may treat an object as if it were something else (e.g., while pretending to talk on the phone, a child holds a banana to their ear, thinking of the banana as a phone), act as if they were someone else, or engage in an activity as if they were doing something else (e.g., feeding a baby as a caregiver) (Garvey, 1990; Lillard, 1993). In these cases, similar to metaphorical comprehension, children block the object's prominent function (banana) and reconceptualize it using another vehicle (phone). Due to the similarity between pretend play and metaphor production, several earlier studies even considered instances of pretend play as metaphor production (Billow, 1981; Winner, 1979; Winner et al., 1979; Winner et al., 1980). For example, making a toy animal eat grass, represented by the experimenter's hair, was interpreted as metaphorical (Billow, 1981). This treatment is problematic since to form a link between a vehicle and a topic in a metaphor, there needs to be a shared attribute, but this is not necessary for pretend play (Vosniadou, 1987). Yet, although it is not a requirement, perceptual similarities between the vehicle and topic are often observed in pretend play as well (Garvey, 1990). Therefore, it is clear that both concepts have similarities in terms of imposing familiar schemas on novel concepts, which provides a basis for anticipating a positive relationship between them.

The final cognitive factor we plan to investigate is the complexity of children's language use. Metaphor comprehension is considered a linguistic capacity (Özçalışkan, 2005; Vosniadou, 1987); however, there is limited research in this area. A few studies have found that metaphor understanding is positively associated with vocabulary abilities (Pouscoulous & Perovic, 2023) and verbal reasoning (Carriedo et al., 2016). We propose that another language-related domain that may be linked to metaphor comprehension is language complexity, which refers to the sophistication and structural variety of the language children use in their everyday interactions The complexity of language used in everyday contexts may serve as an indicator of children's capacity for metaphor comprehension, as both rely on advanced linguistic processing and abstract reasoning skills. With this in mind, analyzing the structural complexity of children's language can offer valuable insights into their ability to understand psychological metaphors.

To sum up, comprehension of psychological metaphors, cognitive flexibility, and the tendency to engage in pretend play may share similar underlying mechanisms. Therefore, we anticipate a positive association between all of these factors. Furthermore, given that metaphorical language is a more complicated form of speech (Lakoff & Johnson, 1980), we anticipate that children who are more proficient in using complex language will have higher psychological metaphor comprehension skills.

Metaphor-Related Factors

Looking at the metaphor comprehension process from a different angle, we can see that while children's cognitive and linguistic abilities contribute to its development, metaphor-related mechanisms also play a role. For example, in several investigations, researchers discovered that the same children understood certain metaphors but not others (Keil, 1986; Vosniadou et al., 1984), implying that the nature of metaphors influences the comprehension process as well.

Several observations support the common intuition that more complex metaphors are more difficult to understand (Johnson & Pascual-Leone, 1989; Vosniadou et al., 1984; Waggoner & Palermo, 1989; Winner et al., 1976). However, there is no consensus on the operational definitions of "complex" and "simple" metaphors. As a result, different researchers focused on varying aspects of metaphorical phrases that influence overall complexity and, consequently, the comprehensibility of metaphors. Namely, Waggoner and Palermo (1989) utilized the abstract-concrete distinction to compare complex and simple metaphors, whereas Vosniadou et al. (1984) employed the simile-predicative distinction. Additionally, Jones and Estes (2006) introduced aptness as a factor influencing the comprehensibility of a metaphor. We acknowledge the significant effects of these factors; thus, we aimed to control them by using only the predicative form of metaphors, restricting the selection to abstract (psychological) metaphors, and ensuring similar levels of aptness through a pilot study. With these controls in place, we aimed to examine different factors (context and familiarity) that have not been previously addressed but might be particularly important for children.

We believe that the context in which a metaphor is presented can influence its complexity and, consequently, its comprehensibility. As mentioned earlier, in life, we are exposed to abstract language, such as metaphors, within a specific context, which provides various cues to aid interpretation. One illustrative example is the use of facial expressions and intonations during speech, which may aid in understanding metaphorical phrases representing a person's emotions. These cues are universally present and can be noticed by everyone (Nelson et al., 1979). Nonetheless, understanding some cues might require higher-order reasoning; therefore, it may be harder to interpret a metaphor presented with such cues. For example, inferring what someone might feel in a given scenario or during an action can demand higher-order reasoning. While it might be easier to understand the metaphor based on facial expressions, interpreting an action or a scenario in order to understand a psychological metaphor may be less effective for individuals who have not yet developed higher-order reasoning skills. For instance, seeing someone's vase broken and assuming that they will be disappointed upon noticing the broken vase is more difficult than simply observing a person's sad facial expression. This is because it involves two steps: first, having the

emotional understanding capacity necessary to recognize that someone would feel sad in such a scenario, and second, having the capacity to understand the metaphors that describe this feeling in the given scenario. Consequently, we expect that when a metaphor is presented with more accessible and easier cues (e.g., facial expression) that aid interpretation, children's comprehension will be higher compared to metaphors presented with less obvious cues (e.g., embedded in a scenario).

The familiarity of metaphors can be another factor that influences metaphor complexity and, as a result, metaphor comprehension. While we acknowledge that conventionality is a more commonly used measure and is often considered a key factor influencing a metaphor's complexity since it affects how a metaphor is conceptualized (Bowdle & Gentner, 2005), we argue that familiarity can be a more relevant factor when working with children. Assessing the conventionality of metaphors in children can be challenging, as they have varying levels of experience with metaphors. However, we propose that children's familiarity with a given metaphorical phrase may influence their comprehension process in a similar way to how conventionality influences adults' comprehension. Thus, the connection between the topic and the vehicle may be more readily apparent to children only when they are acquainted with the metaphor.

In summary, we expect that children's comprehension performance will differ depending on the level of complexity, influenced by contextual cues and familiarity. Specifically, we predict that easier contexts and more familiar metaphors will facilitate better metaphor comprehension. We also aim to investigate the possible interactions between the levels of metaphor-related factors and executive function, as indicated by the findings of Carriedo et al. (2016). In particular, we expect cognitive flexibility to be more influential when the context is hard and the metaphors are unfamiliar.

The Current Study

To examine how cognitive abilities and metaphor-related factors interact in psychological metaphor understanding, we utilized a methodology similar to the one employed by Waggoner and Palermo (1989). We created ambiguous short stories, each ending with a metaphorical statement. Children were then instructed to select the picture that best represented the ending of the narrative based on the metaphorical term. Through this approach, we intended to eliminate meta-linguistic requirements and offer children a setting in which they could encounter metaphors, mirroring the way they would encounter metaphors in real life rather than simply being presented with the metaphorical phrase.

Previous research (Waggoner & Palermo, 1989) has shown that preschool children (4–5-year-olds) have some level of metaphor comprehension. Accordingly, we chose this

age group to explore these effects in a developmentally relevant context, based on the assumption that it would provide an opportunity to investigate the influence of the aforementioned cognitive and metaphor-related factors on metaphor comprehension.

In conclusion, this study is expected to provide insights into whether preschool children can comprehend psychological metaphors and how both cognitive abilities and characteristics of these expressions influence their understanding. We anticipated positive relationships between cognitive abilities (cognitive flexibility, pretend play, and language complexity) and psychological metaphor comprehension. Furthermore, we hypothesized that metaphors presented in an easier context would be easier to understand than metaphors presented in a harder context. Likewise, we expected better comprehension levels when metaphors are more familiar compared to their less familiar counterparts. Finally, we intended to explore interactions between cognitive and metaphor-related factors with the expectation of cognitive flexibility to facilitate psychological metaphor comprehension with metaphors from harder contexts and with less familiarity.

Method

Participants

The study was conducted with 62 Turkish-speaking preschool children (29 boys, 33 girls) aged from 45 months (3 years, 9 months) to 79 months (6 years, 7 months) (M_{age} = 61 months, SD = 7 months). An additional participant was tested but excluded from the analyses due to the parents' report of a developmental disorder. The targeted number of participants (N = 60) was decided a priori according to the reported sample sizes for the t-tests of Pouscoulous and Tomasello (2020) and Waggoner and Palermo (1989), because previous similar studies did not report effect size.

The children in the main study were recruited from municipality preschools and private preschools. At the end of testing, all of the children in the study received an age-appropriate storybook as a gift and a personalized certificate of "Participation in Science."

Materials and Procedure

After written consent forms were received from the parents, the children were examined in a room at their preschools by the first author. Verbal assent was also obtained from the child before starting the tasks. The researcher conducted a series of tasks in the following order: language complexity, metaphor understanding, cognitive flexibility, and pretend play. As this is a standard practice in individual differences research, the tasks were given in a fixed order (e.g., Carlson & Moses, 2001; Pomareda

et al., 2024). Language complexity and metaphor comprehension tasks were administered via computer. The duration of the testing procedure for each child was approximately 20-25 minutes. A video recording was done throughout the entire testing time, except for the three participants, whose parents refused to consent to visual filming. In those cases, only an audio recording was taken. Following the testing with the children, the parents were requested to complete an online questionnaire that contained demographic questions and familiarity ratings of metaphors using the Qualtrics platform.

Language Complexity

In order to evaluate the complexity of language, the researcher presented a brief (1 minute and 35 seconds long) video clip from a cartoon without sound. After watching the clip, the children were asked to describe what was happening in the cartoon. The depicted cartoon showcased Sylvester the Cat chasing Tweety, the bird in the cartoon, while some chickens on the farm help Tweety evade and hide from Sylvester (see supplementary material for the video clip). In the current study, the language complexity of the children's narratives regarding the cartoon was assessed using a coding system created by Berman and Slobin (1994).

In this system, a clause was defined as a phrase consisting of one or more predicates that describe an action, state, or event. If a clause contained only one predicate, it was considered a simple clause, and if it contained two or more predicates, it was considered a complex clause. For example, "Mary went home" was coded as a simple clause, while phrases such as "Mary went home because her mother called her", "Mary's mother yelled 'Come home'", and "While running back home, Mary fell " were coded as complex clauses. The total number of meaningful words (repetitions included), unique words, clauses, predicates, simple clauses, and complex clauses were coded. To determine the child's ability to use complex language, the number of complex clauses was divided by the total number of clauses uttered by the child.

Two research assistants from the Boğaziçi University's Family and Child Studies Laboratory were trained with pilot language samples, and inter-rater reliability was taken from the codings of six language samples from the main study. A high degree of inter-rater reliability was found between the raters on complex clause percentage measurements: ICC was .98 (95% CI [.86, .99]). Results also showed that ICCs between two raters' scores were high for the total numbers of meaningful words, number of unique words, clauses, predicates, simple clauses, and complex clauses (r's respectively .99, .99, .98, .99, .98, .99 all *p*'s < .05). Two coders then solved their disagreements in the six initially coded language samples and each worked on 28 of the remaining narratives.

Metaphor Comprehension

Short stories of 3-4 sentences were developed for the study. The six stories and twelve metaphors used in the main study were refined through pilot studies in order to counterbalance emotional valence between story sets and obtain similar levels of aptness between metaphors (see supplementary material for stories used in the main study). All stories had two possible endings, which differed by the character's emotions at the end. One ending reflected a positive emotion, whereas the other displayed a negative emotion. The endings included metaphorical terms that children needed to comprehend to understand the emotion depicted in the story. To ensure that the children see just one of the two possible endings for each story, two story sets (A and B) were created. This design helped us assess whether children comprehended the meaning of the metaphorical term rather than guessing what would happen according to the story's build-up.

Whether the context was hard or easy to understand was also controlled between the two story sets. In the easy context condition, children identified the character's feelings by choosing from pictures of facial expressions. In the hard context condition, the children inferred the protagonist's emotion from pictures showing an action or situation (see Figure 1 for examples). Each story set contained six metaphors, three were presented in easy contexts and three were presented in hard contexts (see supplementary material).

As described in Figure 1, the children saw three pictures after each story: a correct picture, an incorrect picture, and a distractor. The distractor, which was different across the story sets, was based on Ekman's (1992) work and depicted an emotion that had the same valence as the correct answer, yet it did not tap into the exact feeling the metaphor describes. More specifically, Ekman (1992) proposed that emotions like happiness and surprise are associated with pleasant outcomes, while sadness, anger, disgust, and fear are linked to unpleasant stimuli. Therefore, we used happiness or surprise as distractors for metaphors depicting positive emotions, and sadness, anger, and fear as distractors for metaphors depicting negative emotions. For instance, in the hard context story in Figure 1, if the story ended with a positive metaphor, then the distractor picture showed a surprised girl who did not find her friend at the doorstep but a mailman carrying a box, and if the story ended with a negative metaphor, then the distractor image depicted a frightened girl who was confronted by a lightning instead of being sad that her friend had not shown up. With this design, we intended to distinguish between whether children can understand the exact emotion the metaphor is describing or just understand the general valence of the emotion (positive or negative).

Procedure	Easy Context	Hard Context
Story Presentation	One day, Ayşe was playing games with her brother Ali. Suddenly, Ayşe noticed a spider in their room and got very scared. She asked Ali to remove the spider. In this situation, *Ali was a lion* .	One weekend, Lale invited her friend Deren to her house to play together. However, it snowed heavily on the day of the meeting and the roads were closed. While Lale was waiting for Deren with hope, she thought she heard a sound at the door. When she opened the door *her hopes faded away* .
Question	Which one of the following pictures could be Ali?	Which one of the following pictures could be Lale?
Picture Selection — Correct		
Picture Selection — Incorrect		
Picture Selection — Distractor		

Figure 1. *Procedure and example materials from the metaphor comprehension task, story set A*

All participants saw two familiarization trial stories and six test stories during the testing, in the same order. The familiarization trials consisted of similes whereas the test trials consisted of metaphors. The experimenter read all the stories to the participants while a neutral filler picture that showed either the characters or the situation was on

the screen. Then she asked, "Which of the following pictures could be the 'name of the character?'" and showed the three pictures to the children. The children were asked to point to the picture they thought was the correct one. Initially, the correct responses were coded as 2, the distractor responses were coded as 1, and the incorrect responses were coded as 0. Using this coding system, we aimed to control for distractors and evaluate whether children's performance exceeded the chance level by selecting correct pictures over distractors and incorrect options. For the actual metaphor comprehension analyses, correct responses were coded as 1 and both distractor and incorrect responses were coded as 0.

The children's familiarity with the metaphors used in the study was calculated based on the parents' reports. After the data collection, we asked the parents to rate their children's familiarity with the 12 metaphorical phrases that were used in the study, using a Likert scale from 1 "not familiar at all" to 5 "very familiar". Based on these ratings, metaphors were categorized as either more or less familiar.

Cognitive Flexibility

The Dimensional Change Card Sorting (DCCS, Zelazo, 2006) task that was adapted from the study of Frye et al. (1995) to measure set-shifting abilities and flexibility in older preschoolers was used in this study. The experimenter presented the color game, the shape game, and the border game, respectively, in which children had to sort the cards according to the rules of each game and change their way of sorting once the rules changed. The child's scores were calculated separately for each rule change, and each correct placement was given 1 point. The total score was calculated by adding up the scores for each section with higher scores indicating higher cognitive flexibility skills (the maximum possible score was 24, see supplementary material for detailed procedures).

Pretend Play

Affect in Play Scale - Preschool Version (APS-P, Kaugars & Russ, 2009) was administered to assess the play behaviors of 4-6-year-old children during a 5-minute structured free play session. Children were given 5 minutes to freely play and narrate a story with the standardized toys provided (e.g. softball, plush bears, a car, etc., see supplementary materials for a detailed procedure of the task).

The play sessions were video recorded to be coded later. In the original scale, the coding was carried out in three main categories: Subjective coding (imagination-pretense, organization, elaboration-complexity, and interest-involvement-comfort), affect, and the play type (pretend, functional, and no play). For the current study, only the last category was coded. The type of play the child engaged in, whether pretend

play (e.g. using a toy car as a telephone), functional play (e.g. rolling a ball), or no play, was coded for each 20-second period of the total playtime. The ratio of the periods in which the child engaged in pretend play to the total number of times the child continued playing was analyzed as a measure of the child's tendency to engage in pretend play.

Two research assistants from the Boğaziçi University's Family and Child Studies Laboratory coded the play sessions according to the above-mentioned criteria. Coders were first trained using 5 free play sessions from the main study, and then the inter-rater reliability ratings were obtained using another 12 free play sessions. Results showed high inter-rater reliability for the detection of pretend play in the free play session: ICC was .97 with 95% CI [.79, .98] (F (11,11) = 29.14, $p < .001$). After resolving the disagreements on the 17 sessions they initially coded, the assistants coded the remaining play sessions separately ($N = 21$ each).

Demographic Form

The form given to the parents consisted of basic demographic questions and metaphor familiarity questions (see details in supplementary material). The form was shared with the parents after the session with the children to avoid possible clues parents might give to their children, when looking at the familiarity questions of metaphors.

Results

Preliminary Analyses

Before conducting the main analyses to address the research questions of this study, preliminary analyses were carried out to examine the descriptive characteristics of the dataset and to assess whether it met the assumptions required for the planned statistical analyses. All analyses were done with R (R Core Team, 2024) and IBM SPSS Statistics 29.

The children were randomly assigned to see one of the story set conditions (A = 30 or B = 32). Metaphor comprehension performance, familiarity ratings with metaphors used in this study and the age distribution of participants did not differ between the story sets A and B (Table 1). Therefore, the difference between story sets was not controlled in further analyses. Additionally, gender distribution (A: 16 girls, 14 boys; B: 17 girls, 15 boys; X^2(1, $N = 62$) = .00, $p = .99$) was found to be similar across story sets, as well. Then, how gender might be linked with metaphor comprehension was analyzed, and the boys and girls were found to perform similarly (Girls $M = 63.89$, $SD = 19.17$; Boys $M = 62.36$, $SD = 20.97$, t(60) = .301, $p = .76$); thus, gender would not be used in the upcoming analyses either.

Table 1. *Mean metaphor comprehension, familiarity and age in two story sets*

	Set A Means *(SD)*	Set B Means *M (SD)*	*t*	*df*	*p*
Metaphor comprehension (%)	60.56 (22.09)	65.63 (17.55)	−1.00	60	.32
Familiarity	3.04 (.70)	2.97 (.68)	.375	57	.71
Age (months)	60.67 (6.93)	62.09 (7.66)	−.768	60	.45

Then, analyses were conducted to formulate a collapsed familiarity score per story and classify stories as more or less familiar, accordingly. To do so, familiarity ratings of the individual stories that were received from the parents ($N = 59$) were examined. A within-subject ANOVA showed that although familiarity did not differ between story sets, familiarity levels of metaphors differed significantly across stories (F (5,54) = 4.288, $p = .02$, $\eta p^2 = .28$). Familiarity ratings of the 1st story ($M = 3.54$, $SD = 1.10$) was higher than the 2nd ($M = 2.78$, $SD = 1.19$; 95% CI [.08, 1.44], $p = .02$) 3rd ($M = 2.86$, $SD = 1.17$; 95% CI [.10, 1.25], $p = .01$), 4th ($M = 2.78$, $SD = 1.23$; 95% CI [.18, 1.34], $p = .002$) and 6th ($M = 2.95$, $SD = 1.33$; 95% CI [.06, 1.13], $p = .02$) story but did not significantly differ from the 5th story ($M = 3.12$, $SD = 1.20$; 95% CI [−.23, 1.08], $p = .78$). The familiarity ratings of the 2nd, 3rd, 4th, 5th, and 6th stories did not significantly differ from each other. After considering the pairwise comparisons, mean scores of the 1st and 5th stories were calculated and used as more familiar metaphors while mean scores of the 2nd, 3rd, 4th, and 6th stories were used as less familiar metaphors. An additional within-subject t-test was run to make sure the familiarity ratings of more familiar (the 1st and 5th) metaphors are significantly higher than less familiar (2nd, 3rd, 4th, 5th, and 6th) metaphors. Results showed that the group classified as more familiar ($M = 3.33$, $SD = .81$) indeed had higher familiarity ratings compared to the group classified as less familiar ($M = 2.84$, $SD = .81$, $t(58) = 4.11$, $p < .001$).

After that, normality and outlier analyses were conducted with the main variables of interest. Normality and outlier assumptions were met for all variables except for the language complexity. Data revealed that children generally used less complex language; thus, the variable showed a floor effect (skewness = −1.88, $SD = .33$, kurtosis = 4.80, $SD = .64$), and it had two outliers with 80% ($Z = 3.07$) and 100% ($Z = 4.07$) complex language usage. However, since this usage was believed to be a valid representation of the children's language use and the sample size for the variable was large enough ($N = 56$) to assume robustness, these data points were kept in the dataset. Finally, assumptions like homogeneity of variance, collinearity, etc. were checked during the analysis and reported if there were any violations.

Main Analyses

Descriptives

Descriptives and correlations of age with the performances in behavioral tasks can be seen in Tables 2 and 3. Results revealed a significant relationship between metaphor comprehension and age, $r(62) = .27$, $p = .04$. Correlation analyses also showed a significant positive relationship between metaphor comprehension and cognitive flexibility, DCCS, $r(62) = .31$, $p = .02$. In contrast to our hypotheses, the correlations between metaphor comprehension and other cognitive variables (pretend play and language complexity) were not significant.

Table 2. *Descriptives of age and performance in the behavioral tasks*

	N	Minimum	Maximum	Mean	SD
Age (months)	62	45	79	61.40	7.30
Metaphor Comprehension (%)	62	8.33	100	63.17	19.88
Language Complexity (%)	56	0	100	18.36	20.13
Cognitive Flexibility	62	6	23	15.13	5.45
Pretend Play (%)	60	0	100	62.74	30.78

Note. The summed-up scores of DCCS were used for the Cognitive Flexibility measure.

Table 3. *Correlations for age and performance in the behavioral tasks*

|	1	2	3	4	5
1. Age (months)	–				
2. Metaphor Comprehension (%)	.27*	–			
3. Language Complexity (%)	.12	.09	–		
4. Cognitive Flexibility	.18	.31*	–.14	–	
5. Pretend Play (%)	-.01	-.04	.22	.11	–

Note. The summed-up scores of DCCS were used for the Cognitive Flexibility measure. *$p < .05$.

Metaphor Stories

To understand whether the children understood the metaphors presented in stories, a within-subject ANOVA test was conducted and the test revealed that the response

types (correct, distractor, incorrect) of the children differed significantly (F(2, 60) = 39.566, p < .001, ηp^2 = .57). Bonferroni corrected pairwise comparisons further showed that children had significantly more correct responses (M = 3.24, SD = .17) than distractors (M = 1.66, SD = .15, 95% CI [.835, 2.326], p < .001) and incorrect responses (M = 1.10, SD = .11, 95% CI [1.544, 2.747], p < .001). Distractor responses were observed more than incorrect responses as well (95% CI [.056, 1.073], p = .03). These findings indicate that children not only understood the valence of the psychological metaphorical phrase but also understood the specific emotion the metaphor conveyed.

Subsequently, Chi-Square analyses were conducted for each story to examine individual patterns of stories. Tests yielded significant results (all p's < .001) for all stories except for the 6th story (χ^2 = 4.290, p = .12). In the 6th story, children's correct responses did not differ from incorrect responses. The correct response percentage was significantly higher than the chance level for the 1st, 3rd, 4th, and 5th stories (respectively 68%, 69%, 58%, and 62%). However, for the second story, the incorrect response percentage was significantly higher than the expected frequency by 54%. The response distribution of the stories can be seen in Figure 2. Overall, the metaphor comprehension task revealed that participants exhibited a substantial level of metaphor comprehension. Nevertheless, some items were more difficult to interpret than expected, suggesting variability in item difficulty across the stimulus set.
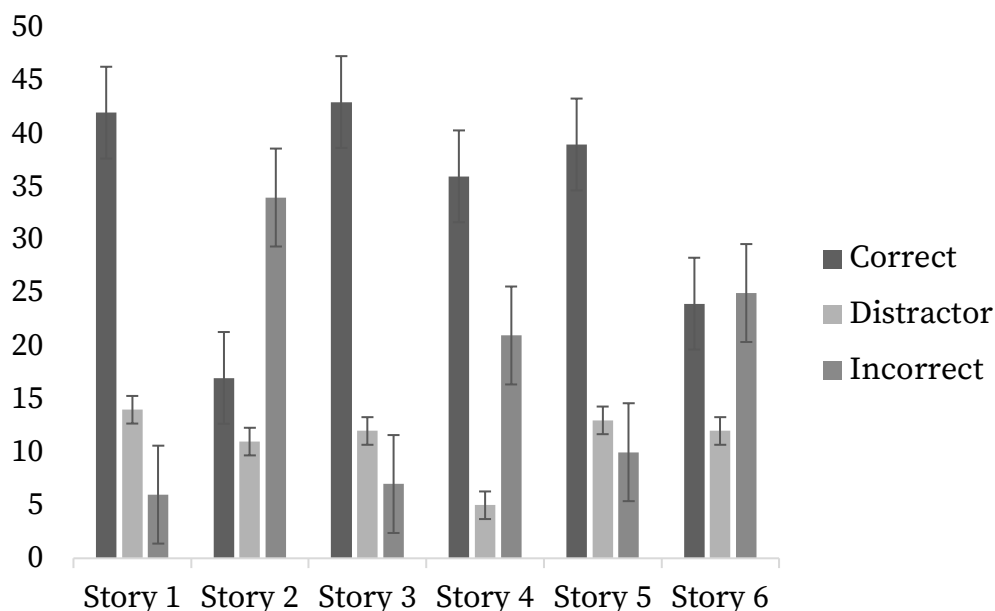
Figure 2. *Percentage of the types of responses by stories*

Cognitive Factors

Initial correlation analyses indicated a connection between metaphor understanding and cognitive flexibility (Table 3), but no association was found between metaphor comprehension and individual differences in pretend play or language complexity. When looking into non-significant cognitive variables, we observed limited variability in both language complexity and pretend play tasks. The lack of variability in utterances in the language complexity task indicated that participants were reluctant to narrate the story (N = 6 missing cases with no verbal response, 25th percentile = 29 words, 50th percentile = 44,50 words, 75th percentile = 79 words). Similarly, while analyzing the patterns in free-play sessions, we saw that children were more inclined to engage in pretend play. The percentage of engaging in pretend play was 40 in the 25th percentile, 66.67 in the 50th percentile, and 93.33 in the 75th percentile, suggesting a ceiling effect. Therefore, the analyses for both factors were repeated with participants above the 50th percentile for clarification; however, results remained unchanged. Consequently, we presented the analyses based on the entire sample.

To further examine whether cognitive factors predicted metaphor comprehension, a logistic mixed-effects model was formed. We used the *glmer*() function from the lme4 package (Bates et al., 2015) in R (R Core Team, 2024) to fit the logistic mixed-effects model. The model used binary coded answers (1: chose the correct picture, 0: chose the distractor or incorrect picture) and included cognitive flexibility scores from the DCCS task, pretend play engagement percentage and complex language use percentage as fixed effects, with random intercepts for both children and story number to account for individual differences and repeated measures across the six stories each child read.

The results indicated that cognitive flexibility was a significant predictor of metaphor comprehension (β = .06, *SE* = .03, p = .01). Specifically, for every one-point increase in cognitive flexibility, the odds of comprehension increased by 6% (OR = 1.064, 95% CI [1.01, 1.12]). On the other hand, neither pretend play (β = −.00, *SE* = .00, p = .56) nor the use of complex language (β = .01, *SE* = .01, p = .45) significantly predicted metaphor comprehension. The variance attributed to the children was 0.12 (*SD* = 0.34), and the variance attributed to the story was 0.47 (*SD* = 0.69). These results indicated substantial variability in the children's baseline metaphor comprehension across both individuals and the stories they encountered. The model provided a reasonable fit to the data, with an AIC of 430.5 and a BIC of 453.2. The inclusion of random intercepts for both the children and the story number improved the model fit compared to a simpler model with only a random effect for children (ΔAIC = −19.2).

Metaphor-Related Factors

Another logistic mixed-effects model was conducted to examine the effects of context (easy vs. hard) and familiarity (less vs. more familiar) on metaphor comprehension, coded as a binary outcome. The model included random intercepts for the children and the stories to account for variability across participants and stories. Results indicated that neither context (β = −.07, *SE* = .49, *p* = .88) nor familiarity (β = .76, *SE* = .52, *p* = .15) had a significant effect on predicting metaphor comprehension. In the current model, the variance attributed to the children was 0.25 (*SD* = 0.50), and the variance attributed to the story was 0.29 (*SD* = 053). The model fit statistics were AIC of 498.7 and BIC of 518.3, which are significantly better compared to a model with only the random effects of children (ΔAIC = −11.5).

Exploratory Analyses

Several analyses were conducted to examine whether different levels of cognitive flexibility interact with the levels of metaphor complexity. Before getting into the analyses, for easier interpretation, a median cut categorical cognitive flexibility variable is computed in which scores less than or equal to 18 were labeled as low cognitive flexibility performance (*N* = 49) while scores higher than 18 were labeled as high cognitive flexibility (*N* = 13) performance. First, to see if the effect of cognitive flexibility on metaphors presented in a harder context was more emphasized than metaphors in an easier context, a mixed design ANOVA was performed 2 (low-high cognitive flexibility) x 2 (easy-hard context) using metaphor comprehension as the DV. None of the main effects nor the interaction was significant.

Later, the interaction between cognitive flexibility and familiarity ratings on metaphor comprehension was explored. A mixed design ANOVA 2 (low-high cognitive flexibility) x 2 (more -less familiar metaphors) was conducted to address the hypothesis. The main effect of familiarity was found to be significant with the performance on more familiar metaphors (*M* = 76.20, *SD* = 24.97) being better than less familiar metaphors (*M* = 56.65, *SD* = 24.77; $F(1,60) = 8.611$, *p* = .005, ηp^2 = .13). However, the main effect of cognitive flexibility was not significant ($F(1,60) = .799$, *p* = .38, ηp^2 = .01). Finally, the interaction between cognitive flexibility and familiarity levels was marginally significant ($F(1,60) = 3.751$, *p* = .058, ηp^2 = .06). Bonferroni corrected pairwise comparisons showed that, in the low cognitive flexibility group, the performance on more familiar metaphors (*M* = 77.04, *SD* = 26.44) was significantly higher than on the less familiar metaphors (*M* = 53.57, *SD* = 24.34; 95% CI [14.64, 32.30], *p* < .001) whereas the difference between more (*M* = 73.08, *SD* = 18.99) and less familiar metaphors (*M* = 68.27, *SD* = 23.72) did not significantly differ in the high cognitive flexibility group (95% CI [−12.33, 21.94], *p* = .58).

Discussion

The objective of the present study was to examine the relationship between cognitive and metaphor-related variables in preschoolers' psychological metaphor comprehension. The analyses provided partial support for the study's hypotheses. In contrast to previous theories (Asch & Nerlove, 1960; Piaget, 1926) and consistent with recent research involving preschool-aged children (e.g., Deamer, 2013; Pouscoulous & Tomasello, 2020; Rubio-Fernandez & Grassmann, 2016; Özçalışkan, 2005; Zhu & Gopnik, 2023), the present findings provide further evidence in favor of the hypothesis that preschool-aged children are capable of comprehending psychological metaphors when tested with tasks that have lower linguistic demands.

While recent research has demonstrated that children as young as three years old can understand physical metaphors and several studies indicate that elementary school children can understand psychological metaphors beyond chance levels (e.g., Lecce et al., 2019; Nippold et al., 1984), the present study is crucial in establishing that children as young as four or five years old can comprehend psychological metaphors. Moreover, we observed that children not only grasp the valence of the emotion (positive or negative) but also precisely identify the particular emotion that the metaphors communicate. Consistent with previous findings, our results show that metaphor comprehension increases with age (e.g., Di Paola et al., 2020; Rubio-Fernandez & Grassmann, 2016) and does not differ by gender (Pouscoulous & Perovic, 2023).

The data further confirmed the second hypothesis of the research, which shows the cognitive flexibility subcomponent of EF skills as one of the predictors of metaphor comprehension. To the best of our knowledge, only a limited number of studies have investigated the relationship between executive function skills and children's metaphor comprehension in preschool children (e.g., Deamer, 2013). As mentioned before, Deamer's (2013) work similarly found a relationship between EF skills and metaphor comprehension in 3-5-year-old children. However, unlike the present study, it focused on physical metaphors and examined inhibitory control as a subcomponent of EF. Despite the differences in methodology of the studies, the positive relationship observed in each suggests that executive function skills may be generally associated with metaphor comprehension. In another study, Carriedo et al. (2016) assessed the relationship between EF skills and metaphor comprehension in adolescents. EF skills, in Carriedo et al.'s (2016) study, were evaluated by employing multiple task batteries that assess inhibition, shifting, and updating. Contrary to the findings of the current study and Deamer's (2013) study, no consistent effect of EF skills on metaphor comprehension was observed when utilizing distinct tasks in a sample of 11 and 15-year-olds. However, the discrepancy observed between the findings reported by Carriedo et al. (2016) and the present study may be because EF skills may have a more

substantial impact on metaphor comprehension among younger children. To elaborate, since EF skills are still developing in children, they might have a stronger and more noticeable effect on their ability to comprehend metaphors. Therefore, the presently discussed findings are important for understanding the role of EF skills in a younger demographic, as it is likely to differ from the mechanisms identified in older children and adults.

While Carriedo et al. (2016) did not find a main effect of EF skills, their results indicated that "EF skills play a supplementary role when metaphor comprehension is highly demanding" (p.14). More precisely, they suggest that the contribution of EF skills to metaphor comprehension increases in the presence of special processing difficulties (e.g., limited semantic knowledge) or when metaphors are more difficult to comprehend (e.g., novel metaphors, absence of a context). The interaction analyses in the present data offer some evidence in favor of this hypothesis. Consistent with expectations, cognitive flexibility, in this study, demonstrated a (marginally) more pronounced influence on comprehending unfamiliar metaphors when compared with familiar metaphors. In general, the similarities and differences identified between the present study and prior investigations indicate that although EF skills are significantly related to understanding of metaphors, their effects might differ depending on the complexity level of the expression. Therefore, when analyzing the factors that contribute to the development of metaphor comprehension, it is vital to examine the interaction between individual differences and linguistic components of the metaphor itself, such as familiarity, contextual support, and abstractness.

The subsequent hypothesis, which posited a positive correlation between children's tendency to engage in pretend play and their comprehension of metaphors, was not supported by the data. Nevertheless, the current study provides valuable insight by distinguishing pretend play and metaphor comprehension as separate constructs rather than overlapping cognitive processes. This distinction is particularly important because previous research (e.g., Billow, 1981) often equated instances of pretense with metaphor production, whereas our findings suggest that these abilities may function independently. Alternatively, the lack of a relationship between these variables may be attributed to task characteristics. In the current study, children's pretend play tendency was assessed using a test developed to assess a child's inclination for pretend play, whereas the metaphor task measured their comprehension ability. While it is thought that metaphor comprehension and pretend play operate on a similar underlying mechanism (i.e., dual representation) (Vosniadou, 1987), this relationship might have been more apparent if both constructs had been assessed using ability-based tasks rather than a tendency measure for pretend play. The absence of evidence to support the hypothesis could also be influenced by the characteristics of the sample. The sample exhibited a high tendency to participate in pretend play, with minimal scope for deviation. Observing the proposed effects might be attainable with

a more diverse sample.

The findings did not support the hypothesis that children's complex language use is related to their metaphor comprehension. These results contradict existing work that views metaphor comprehension as a linguistic ability (Özçalışkan, 2005; Vosniadou, 1987). Based on these accounts, it is anticipated that different linguistic abilities will exert an influence on the comprehension of metaphors. For instance, a positive correlation was identified by Carriedo et al. (2016) between the ability to comprehend metaphors and verbal reasoning. Similarly, Pouscoulous and Perovic (2023) noted a positive association between proficiency in vocabulary and metaphor comprehension. The absence of a correlation in the present study may be a result of the task's attributes, as well. In the current task, participants' preferred language use is assessed, rather than their proficiency in complex language. A stronger link between a task that assesses linguistic skill and metaphor comprehension is more likely to be discovered. Furthermore, a closer link between abstract language proficiency and metaphor comprehension could also be expected since metaphors are a part of abstract language and could be more closely related to abstract language proficiency rather than general language proficiency. Moreover, in line with prior research (e.g., Lecce et al., 2019), the children who participated in the present study not only exhibited a reluctance to offer verbal explanations but also tended to prefer simple language, allowing for minimal space for interpretational variation. This observed reluctance and the simplicity of responses may be similar to the shortcomings of earlier metaphor comprehension studies (e.g. Asch & Nerlove, 1960) that interpreted the lack of response as an indication of non-comprehension. This suggests that the linguistic demands of the language complexity task of the current study might have masked the relationship between complex language skills and metaphor comprehension abilities.

In addition to exploring the effect of cognitive variables, the current study also attempted to reveal the effect of metaphor-related factors on metaphor understanding. The lack of agreement in the literature about the definition of simple and complex metaphors (Johnson & Pascual-Leone, 1989; Vosniadou et al., 1984; Waggoner & Palermo, 1989; Winner et al., 1976) has led us to the examination of several aspects that may influence the level of complexity in a metaphor. One such factor was the context in which the metaphor was presented. Previous research suggests that the complexity of contextual cues affects children's understanding of metaphors. For instance, Vosniadou et al. (1984) showed that in a comparable study, children's comprehension performance improved when they were provided with more predictable story endings, as opposed to those that were less predictable. However, our findings did not support this hypothesis as we did not find a relationship between the context and metaphor comprehension. This discrepancy may be attributed to the task characteristics which can be improved in follow-up studies. For instance, whether a context is easy

or hard can be normed with an a priori pilot study.

The findings did not provide consistent support for the hypothesis proposing a better metaphor comprehension when a metaphor is more familiar. However, this study is important as it takes the familiarity of the metaphors into account while the recent research has mainly concentrated on children's understanding of novel metaphors (e.g., Deamer, 2013; Pouscoulous & Tomasello, 2020; Waggoner & Palermo, 1989). Despite the lack of a main effect, as reviewed above, the data suggest that levels of familiarity interact with the cognitive flexibility skill of children. Specifically, higher cognitive flexibility might have predominantly contributed to the comprehension of less familiar metaphors rather than more familiar metaphors.

The study also acknowledges certain limitations, particularly in the use of visual materials in assessing metaphor comprehension. As analyses revealed, not all of the metaphor comprehension stories worked in the intended direction. Performance on different stories was expected to differ by their complexity levels; nevertheless, for instance, the poor performance in the second story seems to be due to the visual material used in the study. The phrase "eli ayağına dolaştı" in the story set A has the literal translation of "she got caught up in her feet". The psychological meaning of the metaphor suggests that the person is anxious or worried. Participants tended to choose the incorrect picture, which is the only picture where the girl's hands are in a different position, standing with her hands on her hips rather than a neutral position with her hands down. This position might be interpreted as her arms being tangled in some way. Furthermore, it is also possible that the correct picture does not accurately portray an anxious person (see supplementary material for pictures of stories).

Another limitation of the images is that, although they were created based on previous research (Ekman, 1992), they were not normed according to the emotions they were meant to represent or the complexity of the context they were presented. This could be problematic, as the emotional valence and the complexity of the context might be interpreted subjectively. This highlights the challenge in designing effective metaphor comprehension tests and suggests a need for refining visual and textual elements in future research with a norming study.

Despite its limitations, the current study is significant and novel in several aspects. To our knowledge, this is the first study to assess preschool children's metaphor comprehension using a behavioral paradigm in a Turkish sample. The findings are crucial in demonstrating that preschool children possess a certain level of comprehension of psychological metaphors. Another strength of the study is its examination of both individual and metaphor-related variables, as well as their interactions, which is essential for a comprehensive understanding of the factors that contribute to metaphor

comprehension. Further research could expand these findings by investigating different factors such as Theory of Mind (ToM), dual representation skills, and abstract language competence, which may differentially influence the development of metaphor comprehension across various developmental stages and metaphor types. For example, Tonini et al. (2023) found that better ToM skills improved psychological metaphor comprehension but not physical metaphor comprehension in early middle school children. Furthermore, the impact became non-significant for older middle school children. These findings suggest that ToM skills may play a crucial role in the early development and use of psychological metaphors, which warrants further research.

In conclusion, this study demonstrates that preschoolers possess the ability to understand psychological metaphors, with cognitive flexibility skills playing a significant role in this process. The results suggest that cognitive flexibility may facilitate metaphor comprehension, particularly for less familiar metaphors, while pretend play and language complexity did not show significant associations. These findings challenge earlier assumptions about young children's metaphor comprehension capabilities and highlight the need for further research with more refined methodologies considering both cognitive and metaphor-related factors. Identifying the cognitive factors influencing metaphor comprehension and their interaction with the metaphor-related factors in early childhood can help us understand how children may employ the "meaning-forming" function of metaphors to regulate their own emotions (Faranda, 2014; Karaırmak, 2015; Lapsekili & Yelboğa, 2014). Specifically, grasping metaphorical language, which often conveys emotional or abstract content, may help children make sense of their emotional experiences and develop strategies for emotion regulation. Consequently, this study provides a foundational basis for future research exploring the interplay between cognitive development, psychological metaphor comprehension, and emotional growth in early childhood.

References

Asch, S., & Nerlove, H. (1960). The development of double function terms in children: An exploratory study. In B. Kaplan & S. Wapner (Eds.), *Perspectives in Psychological Theory* (pp. 47–60). International Universities Press.

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software, 67*(1), 1–48. https://doi.org/10.18637/jss.v067.i01

Berman, R. A., & Slobin, D. I. (1994). *Relating events in narrative: A cross-linguistic developmental study.* Erlbaum.

Billow, R. M. (1981). Observing spontaneous metaphor in children. *Journal of Experimental Child Psychology, 31*(3), 430-445. https://doi.org/10.1016/0022-0965(81)90028-X

Blank, G. D. (1988). Metaphors in the lexicon. *Metaphor and Symbolic Activity, 3*, 21–36. https://doi.org/10.1207/s15327868ms0301_2

Bowdle, B. F., & Gentner, D. (2005). The career of metaphor. *Psychological Review, 112*(1), 193-216. https://doi.org/10.1037/0033-295X.112.1.193

Carlson, S. M., & Moses, L. J. (2001). Individual differences in inhibitory control and children's theory of mind. *Child Development, 72*(4), 1032-1053. https://doi.org/10.1111/1467-8624.00333

Carriedo, N., Corral, A., Montoro, P. R., Herrero, L., Ballestrino, P., & Sebastián, I. (2016). The development of metaphor comprehension and its relationship with relational verbal reasoning and executive function. *PLoS One, 11*(3), e0150289. https://doi.org/10.1371/journal.pone.0150289

Chronaki, G., Hadwin, J. A., Garner, M., Maurage, P., & Sonuga-Barke, E. J. (2015). The development of emotion recognition from facial expressions and non-linguistic vocalizations during childhood. *British Journal of Developmental Psychology, 33*(2), 218-236. https://doi.org/10.1111/bjdp.12075

Cometa, M. S., & Eson, M. E. (1978). Logical operations and metaphor interpretation: A Piagetian model. *Child Development, 49*(3), 649-659. https://doi.org/10.2307/1128232

Deamer, F. (2013). *An investigation into the process and mechanisms underlying the comprehension of metaphor and hyperbole* [PhD thesis]. University College London.

Di Paola, S., Domaneschi, F., & Pouscoulous, N. (2020). Metaphorical developing minds: The role of multiple factors in the development of metaphor comprehension. *Journal of Pragmatics, 156,* 235-251. https://doi.org/10.1016/j.pragma.2019.08.008

Ekman, P. (1992). Are there basic emotions? *Psychological Review, 99*(3), 550–553. https://doi.org/10.1037/0033-295X.99.3.550

Fainsilber, L., & Ortony, A. (1987). Metaphorical uses of language in the expression of emotions. *Metaphor and Symbol, 2*(4), 239-250. https://doi.org/10.1207/s15327868ms0204_2

Faranda, F. (2014). Working with images in psychotherapy: An embodied experience of play and metaphor. *Journal of Psychotherapy Integration, 24*(1), 65-77. https://doi.org/10.1037/a0035967

Fetterman, A. K., Bair, J. L., Werth, M., Landkammer, F., & Robinson, M. D. (2016). The scope and consequences of metaphoric thinking: Using individual differences in metaphor usage to understand how metaphor functions. *Journal of Personality and Social Psychology, 110*(3), 458-476. https://doi.org/10.1037/pspp0000067

Frye, D., Zelazo, P. D., & Palfai, T. (1995). Theory of mind and rule-based reasoning. *Cognitive Development, 10*(4), 483-527. https://doi.org/10.1016/0885-2014(95)90024-1

Gardner, H. (1974). Metaphors and modalities: How children project polar adjectives onto diverse domains. *Child Development, 45*(1), 84-91. https://doi.org/10.2307/1127753

Garvey, C. (1990). *Play* (Vol. 27). Harvard University Press.

Gentner, D. (1977). Children's performance on a spatial analogies task. *Child Development, 48*(3), 1034-1039. https://doi.org/10.2307/1128356

Gentner, D. (1983). Structure-mapping: A theoretical framework for analogy. *Cognitive Science, 7*(2), 155-170. https://doi.org/10.1207/s15516709cog0702_3

Giora, R. (1997). Understanding figurative and literal language: The graded salience hypothesis. *Cognitive Linguistics, 8*, 183–206. https://doi.org/10.1515/cogl.1997.8.3.183

Glucksberg, S., & Keysar, B. (1990). Understanding metaphorical comparisons: Beyond similarity. *Psychological Review, 97*(1), 3-18. https://doi.org/10.1037/0033-295X.97.1.3

Johnson, J., & Pascual-Leone, J. (1989). Developmental levels of processing in metaphor interpretation. *Journal of Experimental Child Psychology, 48*(1), 1-31. https://doi.org/10.1016/0022-0965(89)90038-6

Jones, L. L., & Estes, Z. (2006). Roosters, robins, and alarm clocks: Aptness and conventionality in metaphor comprehension. *Journal of Memory and Language, 55*(1), 18-32. https://doi.org/10.1016/j.jml.2006.02.004

Karaırmak, Ö. (2015). Çocukla psikolojik danışmada metaforik süreç. *Turkish Psychological Counseling & Guidance Journal, 5*(43), 115-127. https://dergipark.org.tr/en/pub/tpdrd/issue/21463/230070

Kaugars, A. S., & Russ, S. W. (2009). Assessing preschool children's pretend play: Preliminary validation of the Affect in Play Scale-Preschool version. *Early Education and Development, 20*(5), 733-755. https://doi.org/10.1080/10409280802545388

Keil, F. C. (1986). Conceptual domains and the acquisition of metaphor. *Cognitive Development, 1*(1), 73-96. https://doi.org/10.1016/S0885-2014(86)80024-7

Kovecses, Z. (1988). *The language of love: The semantics of passion in conversational English.* Bucknell University Press.

Kovecses, Z. (2000). The scope of metaphor. *Topics in English Linguistics, 30*, 79-92.

Küçükerdoğan, P. (2024). *Metaphor Comprehension in Preschool Children* [unpublished master's thesis]. Boğaziçi University.

Lakoff, G., & Johnson, M. (1980). The metaphorical structure of the human conceptual system. *Cognitive Science, 4*(2), 195-208. https://doi.org/10.1207/s15516709cog0402_4

Lapsekili, N., & Yelboğa, Z. (2014). Psikiyatride metafor kullanımı. *Bilişsel Davranışçı Psikoterapi ve Araştırmalar Dergisi, 3*, 116-125.

Lecce, S., Ronchi, L., Del Sette, P., Bischetti, L., & Bambini, V. (2019). Interpreting physical and mental metaphors: Is Theory of Mind associated with pragmatics in middle childhood? *Journal of Child Language, 46*(2), 393-407. https://doi.org/10.1017/S030500091800048X

Lillard, A. S. (1993). Pretend play skills and the child's theory of mind. *Child Development, 64*(2), 348-371. https://doi.org/10.1111/j.1467-8624.1993.tb02914.x

Marriott, S. (2002). Red in tooth and claw? Images of nature in modern picture books. *Children's Literature in Education, 33*(3), 175–183. https://doi.org/10.1023/A:1019677931406

McCrindle, C. M. E., & Odendaal, J. S. J. (1994). Animals in books used for preschool children. *Anthrozoös, 7*(2), 135–146. https://doi.org/10.2752/089279394787001998

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology, 41*(1), 49-100. https://doi.org/10.1006/cogp.1999.0734

Nelson, C. A., Morse, P. A., & Leavitt, L. A. (1979). Recognition of facial expressions by seven-month-old infants. *Child Development*, *50*(4), 1239-1242. https://doi.org/10.2307/1129358

Nippold, M. A., Leonard, L. B., & Kail, R. (1984). Syntactic and conceptual factors in children's understanding of metaphors. *Journal of Speech, Language, and Hearing Research, 27*(2), 197-205. https://doi.org/10.1044/jshr.2702.197

Özçalışkan, Ş. (2005). On learning to draw the distinction between physical and metaphorical motion: Is metaphor an early emerging cognitive and linguistic capacity? *Journal of Child Language, 32*(2), 291–318. https://doi.org/10.1017/S0305000905006884

Pearson, B. Z. (1990). The comprehension of metaphor by preschool children. *Journal of Child Language, 17*(1), 185-203. https://doi.org/10.1017/S0305000900013179

Piaget, J. (1926). *The language and thought of the child.* Harcourt, Brace.

Pomareda, C., Devine, R. T., & Apperly, I. A. (2024). Mindreading quality versus quantity: A theoretically and empirically motivated two-factor structure for individual differences in adults' mindreading. *PLoS One, 19*(6), e0305270. https://doi.org/10.1371/journal.pone.0305270

Pouscoulous, N. (2014). The 'elevator's buttocks': Metaphorical abilities in children. In D. Matthews (Ed.), *Pragmatic development in first language acquisition* (pp. 239–259). John Benjamins Publishing.

Pouscoulous, N. (2023). More than one path to pragmatics? Insights from children's grasp of implicit, figurative and ironical meaning. *Cognition, 240*, 105531. https://doi.org/10.1016/j.cognition.2023.105531

Pouscoulous, N., & Perovic, A. (2023). Linguistic skills and socioeconomic status: Two oft forgotten factors in child metaphor comprehension. *Children, 10*(12), 1847. https://doi.org/10.3390/children10121847

Pouscoulous, N., & Tomasello, M. (2020). Early birds: Metaphor understanding in 3-year-olds. *Journal of Pragmatics, 156*, 160-167. https://doi.org/10.1016/j.pragma.2019.05.021

R Core Team. (2024). *R: A language and environment for statistical computing.* R Foundation for Statistical Computing. https://www.R-project.org/

Rubio-Fernández, P., & Grassmann, S. (2016). Metaphors as second labels: Difficult

for preschool children? *Journal of Psycholinguistic Research, 45*, 931-944. https://doi.org/10.1007/s10936-015-9386-y

Smith, J. W. A. (1976). Children's comprehension of metaphor: a Piagetian interpretation. *Language and Speech, 19*(3), 236-243. https://doi.org/10.1177/002383097601900304

Spiegel, J. A., Goodrich, J. M., Morris, B. M., Osborne, C. M., & Lonigan, C. J. (2021). Relations between executive functions and academic outcomes in elementary school children: A meta-analysis. *Psychological Bulletin, 147*(4), 329–351. https://doi.org/10.1037/bul0000322

Taggart, J., Eisen, S., & Lillard, A. S. (2019). The current landscape of US children's television: Violent, prosocial, educational, and fantastical content. *Journal of Children and Media, 13*(3), 276-294. https://doi.org/10.1080/17482798.2019.1605916

Tonini, E., Bischetti, L., Del Sette, P., Tosi, E., Lecce, S., & Bambini, V. (2023). The relationship between metaphor skills and Theory of Mind in middle childhood: Task and developmental effects. *Cognition, 238*, 105504. https://doi.org/10.1016/j.cognition.2023.105504

Turner, N. E., & Katz, A. N. (1997). The availability of conventional and of literal meaning during the comprehension of proverbs. *Pragmatics and Cognition, 5*, 199–233. https://doi.org/10.1075/pc.5.2.02tur

Vosniadou, S. (1987). Children and metaphors. *Child Development, 58*(3), 870-885. https://doi.org/10.2307/1130223

Vosniadou, S., Ortony, A., Reynolds, R. E., & Wilson, P. T. (1984). Sources of difficulty in the young child's understanding of metaphorical language. *Child Development, 55*(4), 1588-1606. https://doi.org/10.2307/1130028

Waggoner, J. E., Messe, M. J., & Palermo, D. S. (1985). Grasping the meaning of metaphor: Story recall and comprehension. *Child Development, 56*(5), 1156-1166. https://doi.org/10.2307/1130230

Waggoner, J. E., & Palermo, D. S. (1989). Betty is a bouncing bubble: Children's comprehension of emotion-descriptive metaphors. *Developmental Psychology, 25* (1), 152-163. https://doi.org/10.1037/0012-1649.25.1.152

Winner, E. (1979). New names for old emergence of metaphoric language. *Child Language, 6*, 469-491. https://doi.org/10.1017/S030500090000249X

Winner, E., McCarthy, M., & Gardner, H. (1980). The ontogenesis of metaphor. In R.P. Honeck & R. R. Hoffman (Eds.), *Cognition and figurative language* (pp. 335-360). Erlbaum.

Winner, E., McCarthy, M., Kleinman, S., & Gardner, H. (1979). First metaphors. In D. Wolf (Ed.), *Early symbolization: New directions for child development* (pp. 29-41). Jossey-Bass.

Winner, E., Rosenstiel, A. K., & Gardner, H. (1976). The development of metaphoric understanding. *Developmental Psychology, 12*(4), 289-297. https://doi.org/10.1037/0012-1649.12.4.289

Zelazo, P. D. (2006). The Dimensional Change Card Sort (DCCS): A method of assessing executive function in children. *Nature Protocols, 1*(1), 297-301. https://doi.org/10.1038/nprot.2006.46

Zhu, R., & Gopnik, A. (2023). Preschoolers and adults learn from novel metaphors. *Psychological Science, 34*(6), 696-704. https://doi.org/10.1177/09567976231165267

Data, Code, and Materials Availability Statement

The authors confirm that the data, code and materials supporting the findings of this study are available within the article and its supplementary materials in a permanent repository: Metaphor Comprehension in Preschool Children at https://osf.io/rukwf/.

Ethics Statement

The research was conducted following the human ethics guidelines and was approved (2023-38T, Date: 22.12.2023) by the human ethics committee of the Boğaziçi University: Institutional Review Board for Research with Human Subjects.

Acknowledgements

Authorship and Contributorship statement

Pelin Küçükerdoğan conceived of the study, designed the study, collected data, and wrote the first draft of the manuscript. **Deniz Tahiroglu** contributed to the design of the study and revised the manuscript. All authors approved the final version of the manuscript and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

License