



Development of Metaphor Reasoning Comprehension in Infants

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Purpose: This study investigated the development of early metaphor comprehension based on gender and age in preschool children and measured its correlation with vocabulary acquisition.

Methods: A total of forty-nine Korean preschoolers aged 4 to 6 years old (17 boys, 32 girls) with normal receptive and expressive vocabulary development were included in this study. Children were divided into three groups depending on age, their mean ages being 4;8, 5;4, 6;3, respectively. Metaphor reasoning comprehension was measured using MRAC(Metaphor and Reasoning Comprehension Test), and children were asked to listen to a sentence and point to one of the three pictures.

Results: There was no significant difference among the groups in the metaphor reasoning score by age and gender of preschool children ($p>0.05$). In addition, the Pearson correlation showed a positive relationship between metaphor and reasoning comprehension scores, as well as receptive vocabulary scores ($r=0.302$, $p=0.035$) and a positive relationship between metaphor and reasoning comprehension scores and expressive vocabulary scores ($r=0.314$, $p=0.028$). In addition, most errors occur in understanding the literal meaning rather than the implied meaning or metaphor of the sentence.

Conclusion: In early young children, vocabulary plays an essential role in the metaphor interpretation process. However, to better understand the development of metaphor language comprehension in preschool children, exploring other factors affecting their ability to understand metaphor language and investigating their relationships is necessary.

Keywords: Metaphor, Reasoning, Comprehension, Vocabulary knowledge, Preschool children



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INTRODUCTION

Humans communicate in various ways, and we speak our thoughts directly or by using indirect expressions according to the conversational situation and our age. In such an indirect expression method, figurative language is often used, and figurative languages include metaphors, similes, proverbs, and idioms.

Early studies on metaphors said that understanding metaphors develop from a superficial level of understanding literal meanings to grasping abstract metaphors [1] and that metaphors cannot be understood from a physical and psychological perspective until age 9 [2]. Winner, Rosenstiel, and Gardner [3] studied subjects who developed metaphor skills beyond age 14. Recently, however, there has been an increasing trend

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in studies showing that metaphoric ability develops from infancy and that metaphorical language is used from the early stage of language development [1,4-6]. In addition, the Harvard School centered on Chukovsky [7] said that metaphorical ability is only a human's natural ability apart from language ability, while Garder & Winner [8] explained that human metaphor ability is separate from general language ability, general perceptual process, and general conceptualization process [9]. This was explained as a metaphorical characteristic of right hemisphere damage.

These researchers report that young children tend to interpret metaphors as letters, which is not related to language development but rather to processing factors unrelated to metaphors, lack of experience in understanding the world, and immaturity of cognitive function [5].

This study aims to discover the development of metaphor reasoning comprehension of infants aged 4, 5, and 6 in the early stages of language development and to analyze the correlation between metaphor reasoning development and language development.

METHODS

Participants

Seventy-five Korean children aged 4 to 6 were recruited from kindergarten in Gyoungsan (Gyoungsan, Korea). All children had no problems with physical, emotional, or hearing problems, as reported by parents or teachers. All children participated in all tests with the consent of their parents prior to participation, and the children completed the Receptive and Expressive Vocabulary Test (REVT) as a Korean standardized vocabulary test. Among them, children whose vocabulary development did not fall within the normal range in the REVT were excluded from the study, and only children with normal vocabulary development were included in this study. Then, the Metaphor and Reasoning Comprehension (MARC) test was carried out on children within the normal range of Korean vocabulary development. In the case of a 4-year-old, cases in which the MARC test failed to complete or refused to perform the test were also excluded from the test. Finally, forty-nine children with normal receptive and expressive vocabulary development were included in this study. Children were divided into three groups depending on age. The 4-year-old group consisted of 10 children (8 girls and 2 boys) ($M=4;8$, $SD=0.4$ years), the 5-year-old group consisted of 22 children (18 girls and 4 boys) ($M=5.4$, $SD=0.5$ years), and the 6-year-

old group consisted of 17 children (6 girls and 11 boys) ($M=6;3$, $SD=0.4$ years).

Materials

In this study, MARC was used to investigate the developmental steps of metaphor and reasoning skills of preschool children. The MARC test was initially a standardized test tool to test the metaphor reasoning ability of school-age children, but this test was used in this study to measure the development of the metaphor reasoning ability of young children aged 4 to 6. In MARC, metaphors and reasoning comprehension items consist of conceptual and linguistic metaphors, which require contextual identification, personification, and idioms. On the other hand, the degree and difficulty of metaphors consist of low to complex. All items are given one point each, and the total score is obtained by adding the positive response number. It is interpreted that the higher the total score, the higher the metaphorical reasoning ability.

Data collection and analysis

MARC test was conducted in a quiet room with the examiner and the child facing each other in a 1:1 manner, and if the children ask again, they will be told again only once. All tests possess 78 items, and the total test time was 30 to 40 minutes. All items were given 1 point in the positive response, and 'do not know (NR)', 'no response', or 'wrong answer' were given 0 points. The total score was obtained by summing all positive response scores, and the higher the score, the higher the metaphorical reasoning ability.

Statistical analysis

The Kolmogorov-Smirnov test was carried out to examine the normal distribution of data. Since the normal distribution of metaphor and reasoning scores among the groups was not met, Kruskal-Wallis rank sum test was used to examine metaphor scores depending on age. On the other hand, since REVT-R (receptive vocabulary) and REVT-E (expressive vocabulary) scores satisfied the normal distribution, one-way ANOVA was conducted to examine the average score differences among age groups. A Mann-Whitney U test was conducted to examine the difference in the metaphor and reasoning comprehension scores between genders. Significant main effects were evaluated with the Bonferroni test. SPSS (version 22.0) was used for statistical analysis, and a significance level of 0.05 was used.

Table 1. Means and standard deviations of REVT-R (receptive) scores among different age groups

Group	N	Mean (SD)	<i>p</i> -value
4-year-old	10	60.20 (18.43)	0.062
5-year-old	22	61.27 (10.41)	
6-year-old	17	69.71 (9.20)	

Table 2. Means and standard deviations of REVT-E (expressive) scores among different age groups

Group	N	Mean (SD)	<i>p</i> -value
4-year-old	10	65.50 (14.55)	0.107
5-year-old	22	65.59 (10.251)	
6-year-old	17	72.65 (9.180)	

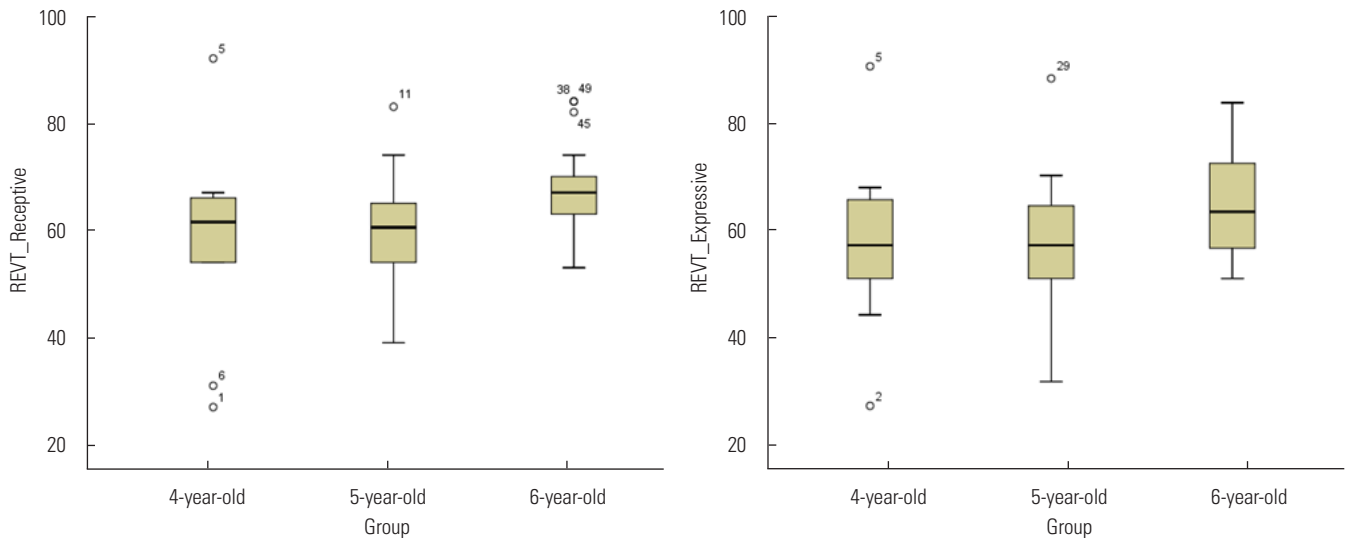


Figure 1. Comparisons of receptive and expressive vocabulary scores among the age group in young children.

Table 3. Comparison of metaphorical reasoning language scores among the age groups

Group	N	rank	<i>p</i> -value
4-year-old	10	21.95	0.661
5-year-old	22	23.88	
6-year-old	17	26.76	

RESULTS

Comparison of receptive and expressive vocabulary development

Tables 1 and 2 show the descriptive statistics of the REVT scores according to age group. The REVT-R and REVT-E scores increased with age, but one-way ANOVA showed that there was no difference between groups according to age, respectively ($F [2, 46] = 2.964, p = 0.062$), ($F [2, 46] = 2.349, p = 0.107$) (Figure 1).

Comparisons of age-related development of metaphorical reasoning language comprehension

Table 3 and Figure 2 show the average rank of preschool chil-

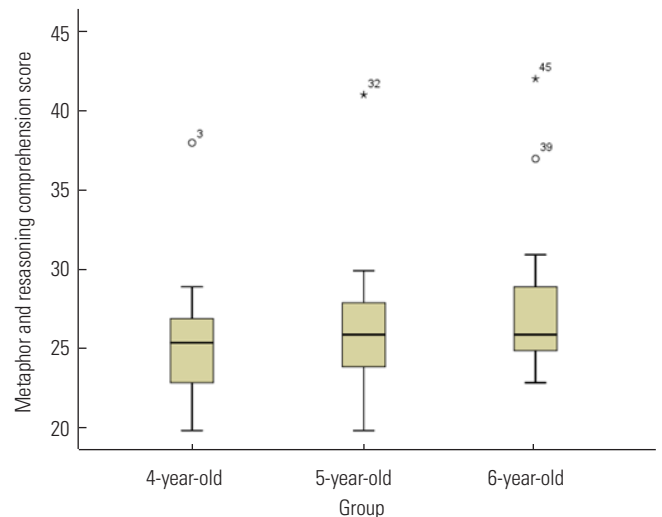
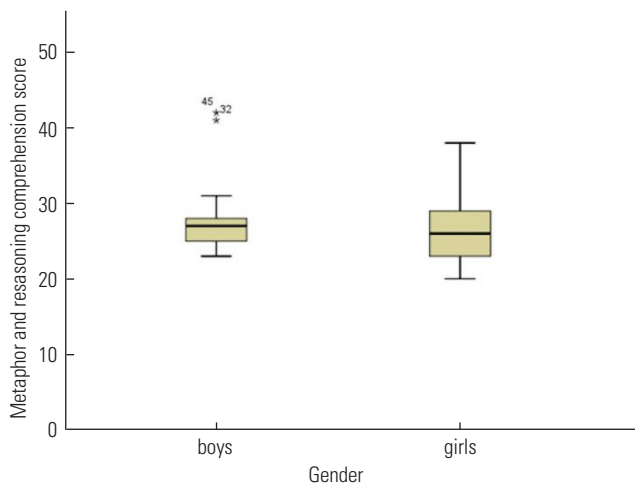


Figure 2. Comparison of metaphor and reasoning comprehension scores among different age groups.

dren's metaphorical reasoning scores for each group and the results of test statistics. As a result of the Kruskal-Wallis rank sum test, there was no significant difference among the groups in the metaphor reasoning score by the age of preschool children ($\chi^2 [2] = 0.829, p = 0.661$).

Table 4. Comparison of metaphorical reasoning language scores between boys and girls

Group	N	Mean rank	<i>p</i> -value
boys	19	27.66	0.733
girls	30	23.32	

**Figure 3.** Comparison of metaphor and reasoning comprehension scores between gender groups.

Comparison of gender-related development of metaphorical reasoning language comprehension

Table 4 and Figure 3 show the descriptive statistics of the score for understanding metaphorical reasoning according to gender. As a result of the Mann-Whitney U test, there was no significant difference between genders ($p > 0.05$).

Correlation between metaphor and reasoning comprehension and vocabulary scores

Table 5 presents the results of Pearson correlation analysis between the metaphor and reasoning comprehension score and the REVT score. Pearson correlation analysis showed a significant relationship between metaphor and reasoning comprehension score, receptive vocabulary score ($r = 0.302$, $p = 0.035$), and expression vocabulary score ($r = 0.314$, $p = 0.028$), respectively.

DISCUSSION AND CONCLUSION

This study investigated metaphor and reasoning comprehension ability in preschool children. When comparing the ability of preschoolers to understand metaphorical reasoning according to gender and age, metaphor and reasoning understanding increased with age, but there was no difference be-

Table 5. Pearson correlation analysis between metaphor and reasoning comprehension and vocabulary scores

	MARC	REVT-R	REVT-E
MARC	-	0.302*	0.314*
REVT-R	0.302*	-	0.685***
REVT-E	0.314*	0.685***	-

* $p < 0.05$, *** $p < 0.001$.

MARC; metaphor and reasoning comprehension score; REVT-R, receptive vocabulary score; REVT-E, expressive vocabulary score.

tween ages. In addition, boys showed higher scores than girls, but there was no statistical significance. In particular, factors such as higher language and contextualization ability were required to understand metaphorical language. According to prior studies, the development of metaphor understanding has reported that infants aged 2 to 3 have already begun to recognize or understand behavior-based metaphors [10], and such early metaphors are gradually used in language [11]. Metaphor identification and comprehension, on the other hand, were considered to develop continuously [12,13] and generally assumed to begin at about the age of five to six. Since metaphor comprehension depends on chronological age and mental age [14,15], it was speculated that children aged five to six begin to understand easier metaphors by constructing separate categories based on simple perceptual grounds and processing them literally [13]. By age eight, children in early school can generally construct a combined category built on multiple perceptual grounds and interpret metaphors based on immediate physical similarities. School-age children aged 9 to 11 could understand more difficult metaphors by forming relational categories based on the perceptual and conceptual ground, and by the early adolescence of 11 to 12, they could understand more accurate and higher conceptual metaphors in the course of school age [16]. A recent study of metaphor identification and comprehension development in school-age children revealed that these abilities consecutively increased with age. They found that early adolescents (11-year-olds) demonstrated significantly higher metaphor comprehension scores than those of 7-year-olds and 9-year-olds, while younger age groups (7-year-olds vs. 9-year-olds) did not differ [13].

In the same way, in the current study, the development of metaphor reasoning comprehension in preschool children also showed an increase with age but no significant differences between 4-year-olds and 6-year-olds. Although the number of participants in the 4-year-old group was small

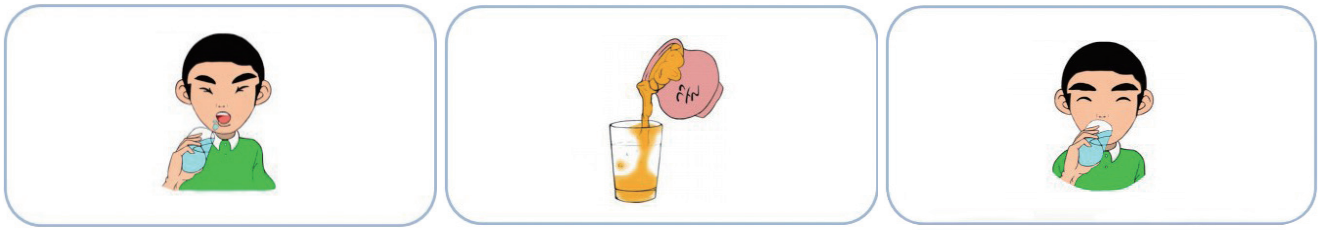


Figure 4. An example illustration of "The water tastes as sweet as honey" in the metaphor and reasoning comprehension test (MARC).

compared to other age groups, our study showed no significant difference in metaphor comprehension scores between the 4-year-old and 5-year-old groups, so it is believed that understanding of metaphor inference already begins at age 4.

On the other hand, inconsistent results were reported for gender differences in metaphor understanding. Boys were considered superior to girls at 3 to 6 [17], while there was no significant difference between genders aged 7 to 10. In the current study, boys scored higher than girls at 4 to 6 in the pre-school age, but there was no difference according to gender.

In addition, children tended to understand metaphors and reasoning better by using familiar objects, situations, materials, or words they already know with more experience in everyday life.

In this study, the context of the picture was provided and pointed out among the three pictures, and children aged 4 to 6 showed the most errors in understanding the meaning literally rather than the implied meaning or metaphor of the sentence. In other words, children of this period responded positively to their experiences or much-learned metaphorical expressions. However, metaphorical languages such as proverbs and reasoning show a literal interpretation, which is inferred to be related to personal knowledge, experience, and higher cognitive skills. Several factors have been mentioned why preschoolers struggle to understand metaphorical language. It was pointed out that young children mainly have limited vocabulary and world knowledge [18] and text/non-text distortion [19], while dependence on contextual cues makes understanding metaphorical language challenging.

Regarding the factors that affect metaphor language comprehension in preschool children, vocabulary acquisition development had a significant positive correlation with metaphorical reasoning comprehension. The development of metaphor comprehension is constrained primarily by limitations on children's conceptual knowledge, linguistic skill, and information-processing ability [20]. Therefore, it is believed that the vocabulary development of preschool children in our

study influenced the semantic development of metaphors.

Interpreting metaphors requires accepting two different labels for entities: literal labels and new figurative labels. Children had problems identifying that "A is like B." As shown in Figure 4, in "The water tastes as sweet as honey," most children chose the honey picture. Although all children in this study had normal vocabulary development, young children tended to interpret metaphors literally. In order to perform this task, it is necessary to understand the semantic relationship between A and B based on the understanding of each word and to use it to infer the meaning of the entire sentence.

Children also had problems understanding nominal indicators, such as "X is a Y" or "Youngman is a bookworm." Youngman is a bug, but Youngman still requires one to understand that he is a person. Our study showed that children aged 4 to 6 struggled with metaphor as a second label. In this study, the average correct response rate of items with "X is a Y" (9, 24, 42, 77) was 18%.

In addition, most preschool children in this study showed difficulty understanding proverbs. For 78 items, items 39, 45, 51, 53, 54, and 62 are proverbs; their correct response rate had an average of 13%. In understanding metaphors, children of this period were found to have the most errors in literally interpreting idioms or figurative language. For example, children often interpreted idioms literally, such as "Cheol-soo has wide feet" and "I turned on the light in my eyes," by pointing out pictures with wide feet or pictures with fire in a person's eyes.

A recent study also found that even in school-age children with typical language development, the younger they were, the more literal they answered [21]. Therefore, these results support the tendency of preschool children in this study to interpret metaphorical understanding simply as the word meaning.

Another study investigated the word inference ability of children with typical language development and SLI aged 5-8 [22]. They found a significant correlation between verbal, ana-

lytical reasoning capability and receptive & expressive vocabulary, sentence comprehension, and nonverbal IQ. Our findings are also consistent with previous studies that vocabulary acquisition seems to predict the development of metaphor language comprehension in preschool.

The limitation of this study was that our study measured the ability to understand metaphors in a relatively small number of children in a specific region. Specifically, 4-year-old children did not include a more significant number of children than other groups, as the number of questions was 78, making it difficult for children to concentrate on the test, with the test including a part of high levels of metaphorical reasoning items that 4-year-old children could not understand. Therefore, in future studies, it is necessary to understand the development of metaphorical reasoning in preschool children, including a wide range of regions and many children. In addition to vocabulary knowledge, it will also help understand the development of metaphor language comprehension in the preschool years by looking at correlations with other factors such as sentence comprehension, meta-linguistic awareness, cognitive ability, and information processing speed that affect the metaphor comprehension process in early young children.

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