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Age, Gender, and Task Type Effects on Embodied Metaphor Comprehension in Persian-Speaking Children

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Abstract: This study examines how age (8 vs. 12 years), gender, and task type (visual/auditory) influence the comprehension of embodied metaphors related to sensory-motor organs (eyes, ears, hands, feet) in Persian-speaking children. Using a cross-sectional design, 160 elementary school children completed metaphor comprehension tests in both visual (image-based) and auditory (story-based) versions. Results revealed developmental differences: 8-year-olds showed superior understanding of hand-related metaphors, while 12-year-olds excelled in eye-related metaphors during visual tasks and ear-related metaphors during auditory tasks. Gender effects emerged across age groups - 8-year-old boys performed better with foot-related auditory metaphors, whereas girls surpassed boys in hand-related visual metaphors. Among 12-year-olds, girls demonstrated superior performance across multiple categories: ear-related and hand-related metaphors. The results also indicated a positive correlation between the metaphors, the task type (visual and auditory), and the sensory channel (ears and eyes) associated with the metaphor. These findings suggest that: (1) embodied metaphor comprehension shifts from haptic to distal sensory domains with age, (2) gender differences in metaphor processing emerge by age 8 and intensify by age 12, and (3) sensory-channel specialization becomes more pronounced with cognitive development. The study provides empirical evidence for designing age- and gender-appropriate linguistic materials in educational contexts.
Keywords: embodied metaphor, child development, age, gender, task type.

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1. Introduction

The conceptualization of metaphor has undergone a paradigmatic shift in cognitive science, transitioning from its traditional perception as a mere literary ornament to its current understanding as a fundamental cognitive mechanism that structures human thought (Lakoff & Johnson, 1980). This epistemological transformation has revealed metaphor as a primary vehicle for embodied cognition, where sensory-motor experiences serve as the foundation for abstract conceptualization. Within this framework, the developmental trajectory of metaphorical competence in children presents a particularly rich area of investigation, as it intersects with crucial aspects of cognitive maturation, linguistic acquisition, and social development.

Contemporary research in cognitive linguistics demonstrates that children's comprehension of embodied metaphors - those rooted in physical experiences of sensory organs (eyes, ears, hands, feet) - follows a discernible developmental pattern. This pattern appears mediated by three principal factors: (1) neurocognitive maturation associated with Piaget's transitional stages from concrete to formal operations, (2) emerging gender dimorphisms in linguistic processing, and (3) specific task type affordances of different presentation formats. The current study seeks to elucidate the complex interplay of these factors in Persian-speaking children during the critical 8-12 year developmental window.

Theoretical considerations suggest several predictable patterns in this developmental continuum. First, the concrete operational cognition of 8-year-olds would predict superior performance with hand-related metaphors ("empty-handed"), given their reliance on tactile-kinesthetic experiences and the primacy of manual exploration in early cognitive development (Piaget, 1952). Conversely, 12-year-olds in the formal operational stage would be expected to demonstrate enhanced competence with metaphors involving distal senses ("sewing eyes to the door" to await someone), as their cognitive apparatus becomes increasingly capable of processing abstract cross-format associations.

Gender differences in metaphor processing may emerge from both neurobiological factors, such as the earlier maturation of language-related cortical areas in females (Shin et al., 2014), and

sociocultural influences that differentially encourage verbal expressiveness in girls. Furthermore, the task type congruence effect - the hypothesized advantage when metaphor presentation format aligns with its sensory domain (visual presentation for eye-related metaphors) - likely becomes more pronounced with age as neural pathways undergo myelination and cognitive specialization.

This investigation employs a carefully designed cross-format paradigm to examine these theoretical propositions systematically. By analyzing developmental differences in embodied metaphor comprehension through both visual and auditory task types, while controlling for linguistic complexity and cultural specificity, the study aims to contribute to three underexplored areas in psycholinguistics: (1) the cultural universality versus specificity of embodied metaphor development, (2) the ontogeny of sensory-task type effects in figurative language processing, and (3) the interaction between biological and environmental factors in shaping metaphorical competence during middle childhood.

The empirical findings promise both theoretical and practical implications. At the theoretical level, they may help reconcile competing accounts of metaphor acquisition in the cognitive development literature. Practically, they could inform the design of developmentally appropriate educational materials and provide diagnostic markers for atypical language development in clinical populations.

2. Literature Review

The development of metaphor understanding in children is a complicated process in which they acquire and extend the scope of their ability to understand metaphor. Extensive research has been conducted on this topic, revealing that children are capable of understanding metaphors from the pre-elementary period onwards; however, this ability evolves with age and cognitive development. The development of metaphor-understanding in children, which is formed based on a child's cognitive development, sensory and social experiences, is an important subject in Cognitive Psychology and linguistics.

Jean Piaget (1952) argued that children have different cognitive capabilities in different stages. He identifies four stages: Sensorimotor stage (0 - 2 years old): in this stage the child, through

their five senses and motor experiences, perceives the world and this aids in shaping the primary thoughts. Preoperational stage (2–7 years old): in this stage the child begins to use symbolic language and thinking but cannot yet understand complex metaphors. Only tangible and concrete metaphors are understood at this age (Piaget, 1958). Concrete operational stage (7 – 11 years old): at this stage, children can understand more complicated concepts and begin to slowly gain the ability to process abstract information (Ginsburg, 1997). Formal stage (11 years and older): the youth can use metaphors and abstract thinking with ease and can understand multi-layered and complicated meanings. (Piaget, 1952).

The studies show that sensory-social experiences have a key role in understanding metaphors. Mead (2010), in one of his research, highlighted that children's everyday experiences and social interactions helps them understand complex concepts such as metaphors. Language, as a tool for communication and expressing concepts, is of great importance in understanding metaphors. Robert Gibbs, in his research demonstrated that increased exposure to language and literature enhances a child's ability to comprehend metaphors. He also emphasized the significance of social interactions and linguistic experiences in this context (Gibbs, 2006).

Some research indicates that girls outperform boys in language and metaphor understanding. Shin et al. found that, generally, girls perform better in understanding metaphors and complex language compared to boys, potentially due to social and cultural influences (Shin., et al, 2014).

Regarding the topic of the present study, we are going to present a review of previous investigations conducted on the subject by different investigators. Bialeka-Pikul (2003) demonstrated that pre-elementary children are capable of understanding simple metaphors in colloquial language. Additionally, Golfam and Ranginkaman (2007) found that children aged 4 to 6 can comprehend metaphors, with their ability improving with age. Sadeghi (2013) also identified a positive correlation between age and metaphor comprehension. Raghibdoost (2015) observed that children aged 6 to 8 exhibit varying degrees of metaphor comprehension, with these differences becoming more pronounced with age. They further noted that perceptual-propositional metaphors are the easiest for children to

understand, whereas psychological-proportional metaphors are the most challenging. Shoja'e Razavi, et al (2016) in their study demonstrated that children between the ages of 2 and 5 show signs of understanding embodied metaphors. They also showed that the understanding of embodied metaphors develops with child's cognition abilities. In another study, Jafari, et al (2023) has shown that the growth of metaphor understanding in elementary children is continued. Although no gender difference was observed in children aged 8, among children 12-year-old girls performed better in understanding metaphors than boys, which may be attributed to the onset of puberty.

The development of metaphor understanding is a complex and multi-layered process, which is under the influence of cognitive stages, social and sensory experiences and linguistic factors. This is not only important for researchers in the fields of psychology and linguistics but also can be used in developing educational and academic curricula. Collectively, these studies indicate that the development of metaphor comprehension is a gradual process that evolves with age and cognitive development.

3. Research Methodology

To address the research questions, the test developed by Soltani (2013), which evaluates the development of metaphor comprehension in children, was employed. This test assesses embodied metaphors related to four sensory-motor organs: the eyes, the ears, the hands, and the feet. It comprises both auditory and visual components, each containing 30 sentences or questions, resulting in a total of 60 questions that participants answer verbally. In the visual component of the test, three sets of images, each set consisting of a pair of photos, were designed. The first image in each pair represents the abstract meaning of the metaphor, the second image depicts the lexical meaning of the concept, and the third image is unrelated to the metaphor's abstract meaning. The participant is then asked to select the most appropriate set of images after hearing the metaphorical expression.

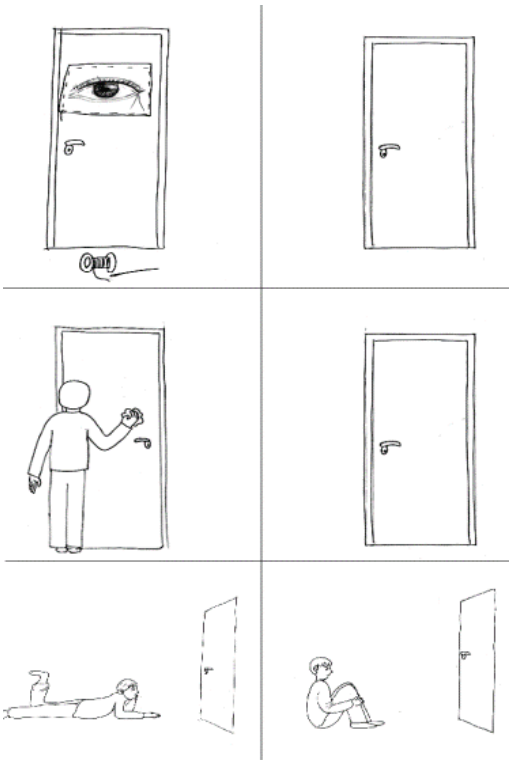

Figure 1: The picture related to conceptual metaphor (to sew one's eyes to the door = waiting for someone) in visual test (Soltani, 2013)

For example, for the metaphor related to "to sew one's eyes to the door" [meaning to await someone or something] in one set of two pictures a child is staring at a door and in the next set of two, a door is seen in one picture and in the other there is an eye sewn to the same door and lastly and in the last picture set, a man is shown cleaning the door.

In the auditory part of the test, a short story is read to the participants. Then the abstract meaning of the metaphor is questioned using a three-option multiple-choice question (one option showing the abstract meaning, one option showing the direct meaning and one unrelated option). Participants are asked to choose the most suitable option. In designing the test high-frequency and simple words are used so that the occurrence of difficult words does

not affect the results of the test. For example, one of the questions about the metaphor “empty hand” (meaning being penniless or in difficulty in Persian) is written below:

"Mohammad has run out of medicine; however, he can’t buy any since his hands are empty."

1- He’s missing one hand
2- He has nothing in his hands
3- He doesn’t have any money

In this question, option one is the unrelated option, option two is the direct meaning, and option three is the abstract meaning of the metaphor.

The target population of the present study consists solely of Persian-speaking students. Since we only had access to Tehran’s schools, participants were selected from Tehran. A representative sample of four districts (Districts 1, 4, 20, and 22) was randomly chosen from the total of 22 districts in Tehran. Within each selected district, one boys' elementary school and one girls' elementary school were identified, contingent upon obtaining the necessary approval from school administrators. Subsequently, a random sample of 20 students was selected from each school, comprising equal numbers of eight-year-old and twelve-year-old students. Consequently, the study involved a comprehensive sample of 160 students, distributed evenly by gender and age group (80 boys and girls, and 80 students aged eight and twelve years, respectively).

Participants answered a series of questions in the auditory and visual tests and their answers were recorded. Every correct answer had one point and wrong answers or not answering had no points. Each test contained 30 questions, so the maximum possible score was 30, and the minimum was 0. Subsequently, the results were statistically analyzed.

In the statistical analysis, the average correct answers of children in each test were compared. To reach a statistical inference, it was necessary to determine whether the test was parametric or nonparametric. There are two general defaults to determine the test type, homoscedasticity and normal distribution of data. When dealing with two variables (e.g., age and gender), Shapiro-Wilk test is used to analyze normal distribution and F^2 to analyze homoscedasticity. When dealing with more than two variables

(metaphor type), Shapiro-Wilk Test is used to analyze normal distribution and Levene's Test is used to analyze homoscedasticity. In situations where normal distribution and homogeneity of variance assumptions were met, independent t-tests were used for data with two variables, and one-way ANOVA tests were used for data with more than two variables. In cases where normal distribution and homogeneity of variance assumptions were not met, Mann-Whitney test was used to analyze data with only two variables and Kruskal Wallis test was used to analyze data with more than two variables. If there was a violation of homogeneity of variance and two variables were present, Welch's t-test were used to analyze the data and in cases of more than two variables Welch's one-way test were used. In all questions of the present study, our null hypothesis was that means of both proportions were equal (H_0: $\mu_1 = \mu_2$) and the alternative hypothesis was that the means were not equal (H_a: $\mu_1 \neq \mu_2$). The significance level of the study was set at 0.05 (α =0.05).

4. Data Analysis

In order to examine the main research questions in more detail and to examine the matter more closely, the research questions were addressed using nine statistical analyses. Each analysis is presented in detail below.

1- In the visual test, what is the difference between the mean of each metaphor in eight-year-old children?

The results of Shapiro-Wilk test indicate a non-normal distribution ($W = 0.974$, $P < 0.001$) and the results of Levene's Test show no violation of homogeneity of variance ($T(3) = 0.72$, $p = 0.540$). Table 1 shows the points obtained by 8-year-old children in the visual test

Table 1: Points obtained by 8-year-old children in the visual test

	Number	Mean	SD
Ears	80	0.44	0.21
Eyes	80	0.47	0.24
Hands	80	0.52	0.207
Feet	80	0.425	0.2

Chart 1 illustrates the distribution of the scores obtained by each 8-year-old child across different kinds of metaphors in the visual test

The results of the nonparametric statistical test of Kruskal–Wallis shows a meaningful difference among metaphor types (H(3) = 9.072, p = 0.28). The results of pairwise comparison of metaphors in don test, as presented in Table 2, indicate a significant difference in the visual test between metaphors related to the hands (M = 0.52) and those related to the ears (M = 0.44, p = 0.024) and feet (M = 0.425, p = 0.007) in 8-year-old children. However, no significant difference was observed between other types of metaphors. According to the means in table 1 and distributions in chart 1, it can be concluded that metaphors related to the hands, eyes, ears, and feet, in descending order, have the highest means.

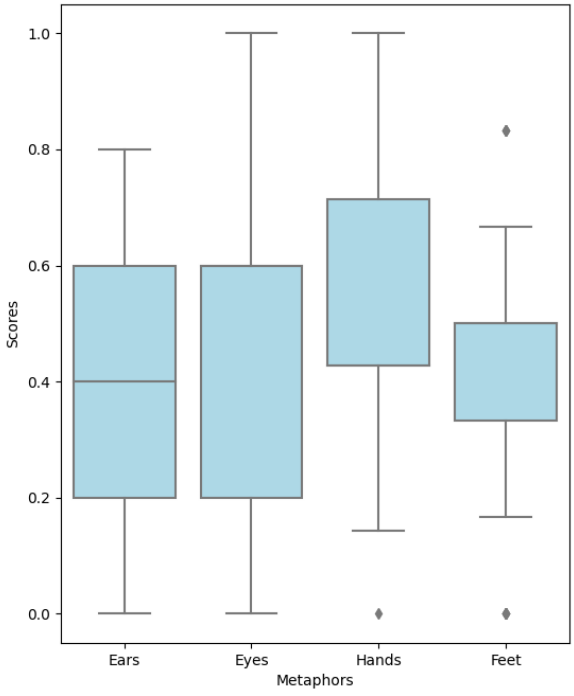

Chart 1: Point distribution of each metaphor for 8-year-old children in the visual test

Table 2: Pairwise Comparisons of Metaphor Types in the Visual Test (8-Year-Olds)

	Ears	Eyes	Hands	Feet
Ears		0.197	*.024	0.66
Eyes	0.197		0.334	0.084
Hands	*.024	0.334		*.007
Feet	0.66	0.084	*.007	

2- In the visual test, what is the difference between metaphor types for 12-year-old children?

The results of Shapiro-Wilk test show a non-normal distribution ($W = 0.865$, $P < 0.001$). Levene test shows no violation of homogeneity of variance ($T(3) = 1.126$, $p = 0.339$). Table 3 shows a description of points obtained by 12-year-old children across different metaphors in the visual test.

Table 3: Description of different metaphors in 12-year-old children in visual test

	Numbers	Mean	SD
Ears	80	0.85	0.15
Eyes	80	0.92	0.14
Hands	80	0.87	0.15
Feet	80	0.89	0.13

Chart 2 displays the distribution of each metaphor for 12-year-old children in the visual test. The results of the nonparametric test of Kruskal-Wallis show a meaningful difference between the types of metaphors (H(3)= 15.759, p= 0.001). The results of pairwise comparison using Dunn's test, which can be seen in table 4, show that there is a meaningful difference between metaphors related to eyes and ears, eyes and feet and eyes and hands in 12-year-old children in the visual test. According to the means presented in table 3 and the distributions in chart 2, metaphors related to the eyes, feet, hands and ears respectively have the highest means.

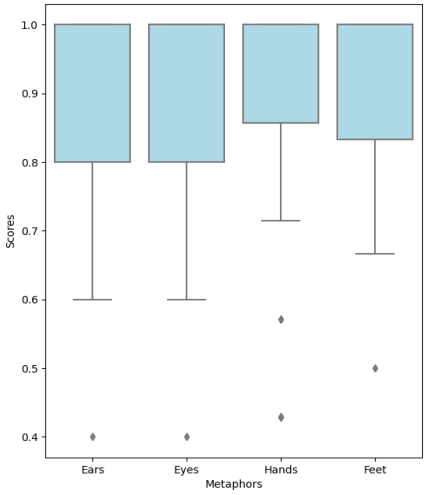

Chart 2: Obtained points distribution for every metaphor in visual test of 12-year-old children

Table 4: Value of p in pairwise comparison of each metaphor in 12-year-old children in the visual test

	Ears	Eyes	Hands	Feet
Ears		*<.001	0.092	*.019
Eyes	*<.001		*.026	0.117
Hands	0.092	*.026		0.506
Feet	*.019	0.117	0.506	

3- In the auditory test, what is the difference between metaphor types for 8-year-old children?

The results of Shapiro-Wilk test show a violation in normal distribution ($W = 0.979$, $p < 0.001$). The results of Levene test show no violation of homogeneity of variance ($T(3) = 1.451$, $p = 0.228$). Table 5 provides a description of the points obtained by 8-year-old children in each metaphor in the auditory test.

Table 5: Description of different types of metaphor in 8-year-old children in the auditory test

	Number	Mean	SD
Ears	80	1.525	0.993
Eyes	80	1.2	0.833
Hands	80	1.962	1.141
Feet	80	1.462	0.826

Chart 3 shows the distribution of each metaphor in the auditory test of 8-year-old children. The Kruskal-Wallis nonparametric test results show a meaningful difference between the types of metaphors ($H(3) = 21.615$, $P < 0.001$). The results of pairwise comparison, as seen in table 6, show that metaphors related to hands have a meaningful difference with other types of metaphors ($M = 1.962$). It should also be noted that the means of metaphors related to ears ($M= 1.525$) are meaningfully greater than the means of metaphors related to eyes ($M = 1.2$) ($p = 0.43$). according to the means presented in table 5 and distributions in chart 3, metaphors

related to hands, ears, feet and eyes respectively have the highest means.

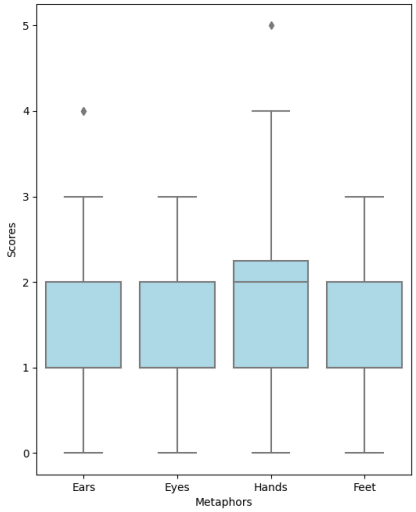

Chart 3: Distribution of points in the auditory test of 8-year-old children

Table 6: The value of p in pairwise comparison of each metaphor in the auditory test of 8-year-old children

	Ears	Eyes	Hands	Feet
Ears		*.043	*.010	0.743
Eyes	*.043		*<.001	0.09
Hands	*.010	*<.001		*.004
Feet	0.743	0.09	*.004	

4- In the auditory test, what is the difference between metaphor types for 12-year-old children?

The results of Shapiro-Wilk test show a violation in normal distribution ($W = 0.964$, $P < 0.001$). Also, the results of Levene test show no violation of homogeneity of variance ($T(3) = 0.798$, $p = 0.496$). Table 7 provides a description of the points obtained by 12-year-old children in each metaphor in the auditory test.

Table 7: Description of the points obtained by 12-year-old children in each metaphor in the auditory test

	Number	Mean	SD
Ears	80	3.738	1.003
Eyes	80	3.188	1.148
Hands	80	3.4	1.208
Feet	80	3.775	1.091

Chart 4 shows the distribution of metaphors in the auditory test of 12-year-old children. The Kruskal-Wallis test results indicate a meaningful difference between the types of metaphors ($H(3) = 15.191$, $p = 0.002$). The pairwise comparison results, which is presented in table 8, show a meaningful difference between metaphors related to the ears ($M = 3.738$), eyes ($M = 3.188$), eyes and feet ($M = 3.775$) and hands and feet ($M = 3.4$). According to the means presented in table 7 and distributions in chart 4 metaphors related to the feet, ears, hands and eyes have respectively the highest means.

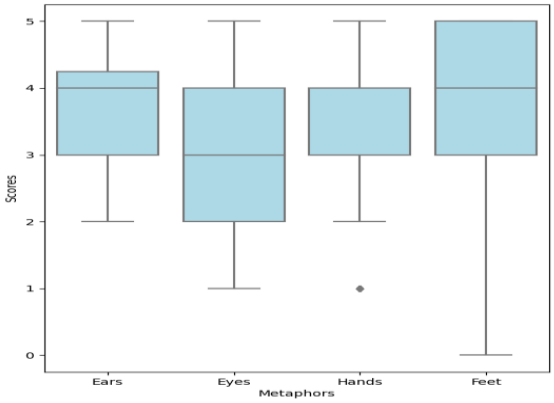

Chart 4: Distribution of points obtained by 12-year-old children in each metaphor in auditory test

Table 8: Value of p in pairwise comparison of metaphors in the auditory test of the 12-year-old children

	Ears	Eyes	Hands	Feet
Ears		*.002	0.114	0.689
Eyes	*.002		0.135	*<.001
Hands	0.114	0.135		*.048
Feet	0.689	*<.001	*.048	

5- In the visual test, what is the difference between 8-year-old boys and girls in each metaphor type?

Table 9, which illustrates the results of the results of Shapiro-Wilk Test, indicates a violation of normal distribution across all metaphors. The results of the F Test, in table 10, show no violation in homogeneity of variance.

Table 9: The results of Shapiro-Wilk Test for each metaphor in the visual test of 8-year-old children disaggregated by gender

Gender	Ears		Eyes		Hands		Feet	
	W	p-value	W	p-value	W	p-value	W	p-value
Girls	0.86	*< .001	0.852	*< .001	0.942	*.041	0.846	*< .001
Boys	0.896	*< .001	0.876	*< .001	0.932	*.019	0.873	*< .001

Table 10: The results of F Test for each metaphor in the visual test of 8-year-old children

Ears		Eyes		Hands		Feet	
F	p-value	F	p-value	F	p-value	F	p-value
1.14	0.289	0.55	0.46	3.84	0.054	2.257	0.137

Chart 5 shows the distribution of each metaphor in the auditory test of 8-year-old children disaggregated by gender. The Mann-Whitney Test results, as shown in Table 11, reveal a significant difference between girls and boys in the visual test, with girls (M = 3.95) outperforming boys (M = 3.325) in metaphors related to the hands (U = 999, p = 0.05). Although it should be noted that this significance is equal to the value of α. No meaningful difference was observed in other types of metaphors.

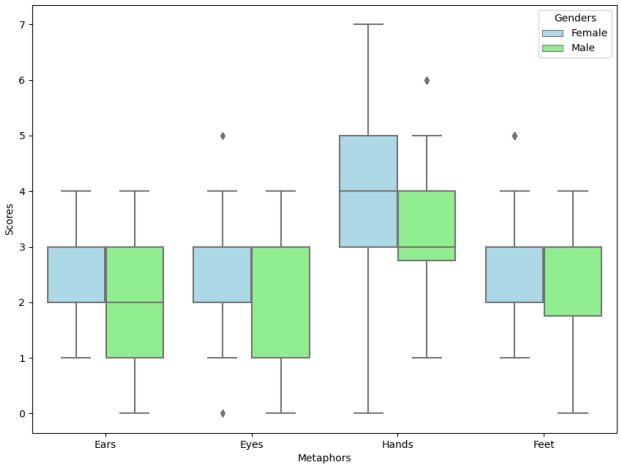

Chart 5: Distribution of points obtained by 8-year-old children in each metaphor in the visual test

Table 11: The results of Mann–Whitney Test of 8-year-old children for each metaphor disaggregated by gender – Visual test

Metaphor	n	M_F	M_M	SD_F	SD_M	U	p-value	df
Ears	40	2.325	2.075	0.797	1.248	913.5	0.259	39
Eyes	40	2.45	2.25	0.959	1.41	828.5	0.778	39
Hands	40	3.95	3.325	1.535	1.309	999	*.05	39
Feet	40	2.75	2.35	1.032	1.331	872	0.474	39

6- In the visual test, what is the difference between 12-year-old boys and girls in each metaphor type?

Table 12, which depicts the results of Shapiro-Wilk Test, shows that the data for all metaphors violate the normal distribution assumption.

Table 12: Results of Shapiro-Wilk Test for each metaphor – 12-year-old children disaggregated by gender in the visual test

Gender	Ears		Eyes		Hands		Feet	
	W	p-value	W	p-value	W	p-value	W	p-value
Girls	0.743	*< .001	0.515	*< .001	0.763	*< .001	0.752	*< .001
Boys	0.821	*< .001	0.68	*< .001	0.803	*< .001	0.767	*< .001

The F Test results in Table 12 reveal a violation of homogeneity of variance in metaphors related to the ears and hands; however, no violation was observed in the metaphors related to the eyes and feet.

Table 13: The results of the F Test for each metaphor in the visual test of the 12-year-old children

Ears		Eyes			Hands		Feet	
F	p-value	F	p-value		F	p-value	F	p-value
4.185	*.044	3.563	0.063		6.441	*.013	0.198	0.658

Chart 6 shows the distribution of each metaphor for the 12-year-old children disaggregated by gender. The results of Mann–Whitney Test, exhibited in table 14, show that in the visual test 12-year-old girls perform significantly better in the metaphors related to the ears (M = 4.425) and hands (M = 6.35) compared to boys (ears: M = 4.1; hands: M = 5.775). For the metaphors related to the ears (U = 992.5, p = 0.043) and for the metaphors related to the hands (U = 1029, p

= 0.019). No meaningful difference was observed in other types of metaphors.

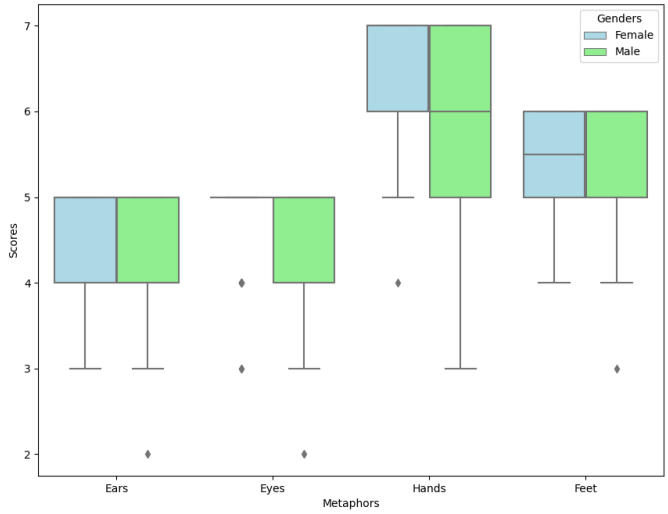

Chart 6: Distribution of points obtained by each gender in each metaphor in the visual test of the 12-year-old children

Table 14: The results of Mann–Whitney Test for each metaphor in the visual test of the 12-year-old children disaggregated by gender

Metaphors	n	M_F	M_M	SD_F	SD_M	U	p-value	df
Ears	40	4.425	4.1	0.675	0.744	992.5	*.043	39
Eyes	40	4.75	4.45	0.543	0.846	935	0.099	39
Hands	40	6.35	5.775	0.802	1.187	1029	*.019	39
Feet	40	5.4	5.325	0.672	0.829	814	0.886	39

7- In the auditory test, what is the difference between 8-year-old boys and girls in each metaphor type?

Table 15, containing the results of the Shapiro-Wilk Test, indicates a violation of normal distribution assumption across all metaphors.

Table 15: The results of Shapiro-Wilk Test for each metaphor in the auditory test of the 8-year-old children disaggregated by gender

Gander	Ears		Eyes		Hands		Feet	
	W	p-value	W	p-value	W	p-value	W	p-value
Girls	0.902	*.002	0.855	*< .001	0.867	*< .001	0.804	*< .001
Boys	0.895	*.001	0.857	*< .001	0.921	*.008	0.877	*< .001

The F Test results in Table 16 show a violation of homogeneity of variance only in metaphors related to the feet. No violation was observed for other types of metaphors.

Table 16: The results of the F Test for each metaphor in the auditory test of the 8-year-old children

Ears		Eyes		Hands		Feet	
F	p-value	F	p-value	F	p-value	F	p-value
0.453	0.503	2.649	0.108	1.164	0.284	7.129	*.009

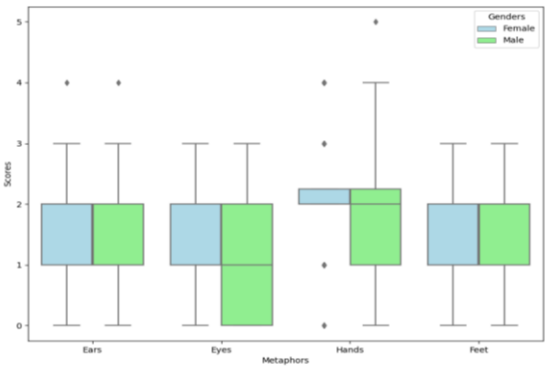

Chart 7: Point distribution for each metaphor in the auditory test of the 8-year-old children, disaggregated by gender

Chart 7 presents the distribution of each metaphor in the auditory test of the 8-year-old children, disaggregated by gender. The results of the Mann–Whitney Test in table 17 indicates that in the auditory test 8-year-old boys significantly outperform girls of the same age in metaphors related to the feet (boys: M = 1.7; girls: M = 1.225; U = 548, p = 0.009). No meaningful difference was observed in other metaphors.

Table 17: The results of the Mann–Whitney Test for each metaphor in the auditory test of the 8-year-olds disaggregated by gender

Metaphors	n	M_F	M_M	SD_F	SD_M	U	p-value	df
Ears	40	1.6	1.45	0.955	1.037	880	0.423	39
Eyes	40	1.35	1.05	0.77	0.876	963	0.096	39
Hands	40	2.1	1.825	1.081	1.196	906.5	0.282	39
Feet	40	1.225	1.7	0.66	0.911	548	*.009	39

8- In the auditory test, what is the difference between 12-year-old boys and girls in each metaphor type?

The results of Shapiro-Wilk Test in table 18 shows a violation of normal distribution across all metaphors.

Table 18: The results of Shapiro-Wilk Test for each metaphor for the auditory test of 12-year-old children gender disaggregated

Gender	Ears		Eyes		Hands		Feet	
	W	p-value	W	p-value	W	p-value	W	p-value
Girls	0.844	*< .001	0.892	*< .001	0.855	*< .001	0.838	*< .001
Boys	0.862	*< .001	0.911	*.004	0.878	*< .001	0.892	*.001

The results of F Test in table 19 show a violation of homogeneity of variance in metaphors related to the hands and feet, with no violations observed for other types of metaphors.

Table 19: The results of F Test for each metaphor in the auditory test of the 12-year-old children

Ears		Eyes		hands		Feet	
F	p-value	F	p-value	F	p-value	F	p-value
2.13	0.148	2.164	0.145	8.442	*.005	5.369	*.023

Chart 8 shows the gender disaggregated distribution of each metaphor in the auditory test of the 12-year-old children. The Mann-Whitney Test results in Table 20 show that in the auditory test, 12-year-old girls (hands: M = 3.775; feet: M = 4.05) significantly outperform boys (hands: M = 3.025; feet: M = 3.5) in metaphors related to the hands and feet (U = 1071, p = 0.007). No meaningful differences were observed in other metaphors.

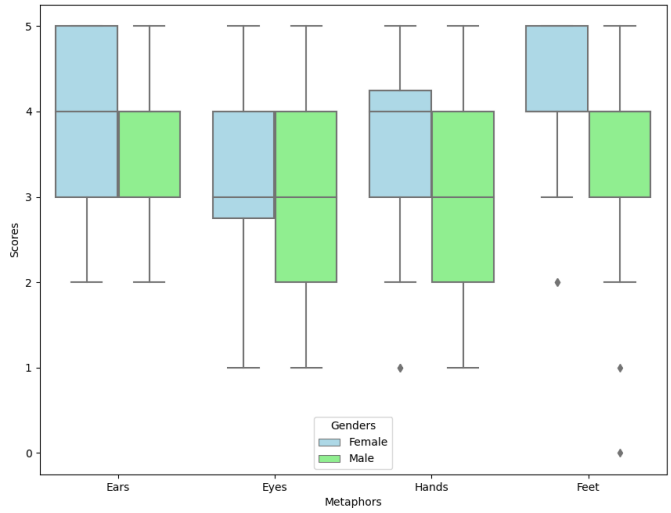

Chart 8: Gender-disaggregated distribution of points obtained in each metaphor by each child in the auditory test

Table 20: The results of Mann-Whitney Test for each metaphor in the auditory test of the 12-year-old children disaggregated by gender

Metaphors	n	M_F	M_M	SD_F	SD_M	U	p-value	df
Ears	40	3.9	3.575	1.033	0.958	952.5	0.126	39
Eyes	40	3.375	3	1.148	1.132	940.5	0.163	39
Hands	40	3.775	3.025	1.05	1.25	1071	*.007	39
Feet	40	4.05	3.5	0.846	1.24	995.5	*.049	39

9- Is there a relationship between metaphor type and task modality? (Comparison of eye- vs. ear-related metaphors)

Table 21 provides a summary of the Shapiro-Wilk Test results, indicating a violation of the normal distribution assumption across all groups.

Table 21: The results of Shapiro-Wilk Test for the metaphors related to the ears and eyes in the auditory and visual tests

Task Type	Ears		Eyes	
	W	p-value	W	p-value
Visual	0.907	*< .001	0.859	*< .001
Auditory	0.927	*< .001	0.924	*< .001

The F Test results show a violation in the homogeneity of variance in the auditory test ($F = 7.264$, $p = 0.007$) and no sign of violation in the visual test ($F = 2.303$, $p = 0.13$).

Chart 9 shows the distribution of children's points in the auditory and visual test, categorized by the metaphor type. The Mann-Whitney Test results in Table 22 indicate that in the auditory test, metaphors related to the ears ($M = 2.631$) are better understood compared to metaphors related to the eyes ($M = 2.194$) ($U = 14955.5$, $p = 0.008$). No significant differences were observed in the

visual test, although the p-value (0.062) is close to the significance threshold ($\alpha = 0.05$).

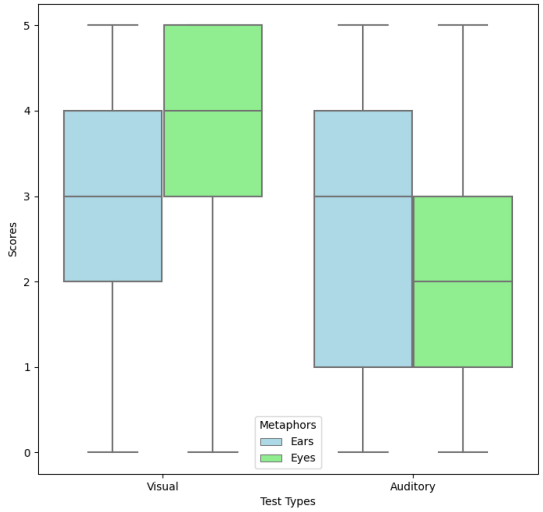

Chart 9: Distribution of metaphors related to the ears and the eyes in the visual and auditory test

Table 22: Results of Mann-Whitney Test for the comparison of the metaphors related to the eyes and ears in the visual and auditory test

Test	Metaphors	n	M	SD	U	p	df
Visual	Ears	160	3.231	1.37	11291	0.062	159
	Eyes	160	3.475	1.5			
Auditory	Ears	160	2.631	1.491	14955.5	*.008	159
	Eyes	160	2.194	1.412			

5. Conclusion

The current study's findings paint a nuanced picture of embodied metaphor comprehension in Persian-speaking children, revealing intricate developmental patterns that merit careful consideration. At the heart of these findings lies a fundamental shift in cognitive processing strategies between childhood and early adolescence,

where the very nature of metaphorical understanding transforms in theoretically significant ways.

Younger children in the 8-year-old cohort demonstrated a distinct cognitive advantage when processing metaphors rooted in manual experiences, such as those involving hand-related imagery. This predisposition aligns remarkably well with what developmental psychology would predict for children solidly within Piaget's concrete operational stage, where physical interaction with the environment serves as the primary mechanism for constructing meaning. The hands, as the child's most immediate tools for exploring and manipulating their world, naturally give rise to the most accessible metaphorical frameworks at this developmental juncture.

As children transition toward adolescence, a fascinating cognitive reorganization becomes apparent in our data. Twelve-year-old participants exhibited a sophisticated capacity for processing metaphors tied to more distal sensory domains—particularly those involving visual and auditory tasks. This developmental trajectory suggests a gradual decoupling from purely physical bases of understanding toward more abstract, task-specific forms of metaphorical thought. The enhanced performance with eye-related metaphors in visual tasks and ear-related metaphors in auditory tasks points to emerging task-dependent specialization in figurative language processing.

Table 23: Ranking of each metaphor in the visual and auditory test age disaggregated

Test	Age	1	2	3	4
Visual	8	Hands	Eyes	Ears	Feet
	12	Eyes	Feet	Hands	Ears
Auditory	8	Hands	Ears	Feet	Eyes
	12	Feet	Ears	Hands	Eyes

The gender differences uncovered in this study add another layer of complexity to our understanding of metaphorical development. While prepubescent children already show some gender-mediated variation in metaphor processing preferences, these differences become substantially more pronounced by age twelve. The female advantage in processing certain types of metaphors may reflect an interaction between neurobiological factors, such as the well-documented earlier maturation of language-related cortical areas in

girls, and sociolinguistic influences that differentially cultivate verbal and figurative expressiveness across genders.

The observed gender effects—where girls outperformed boys in hand- and ear-related metaphors by age 12—align with neurobiological and sociocultural evidence. Neuroimaging studies suggest earlier maturation of language-related cortical areas (e.g., left inferior frontal gyrus) in females (Shin et al., 2014), potentially facilitating abstract metaphor processing. Culturally, Persian-speaking girls may receive more explicit encouragement in verbal expressiveness (Jafari et al., 2023), reinforcing their advantage in tasks requiring figurative language interpretation. However, the cross-modal advantage for boys in foot-related auditory metaphors at age 8 hints at potential gendered differences in embodied cognition pathways, warranting further investigation.

Perhaps most theoretically significant is the discovery of an evolving sensitivity to task-type alignment—the cognitive advantage that emerges when the task type (e.g., visual vs. auditory) aligns with the metaphor's sensory domain (e.g., eyes vs. ears). Our youngest participants showed only rudimentary sensitivity to this alignment, while adolescents demonstrated robust task-specific processing advantages. This developmental progression implies that the neural architecture supporting metaphorical thought becomes increasingly specialized and efficient during this critical period of cognitive development.

The educational implications of these findings are both immediate and profound. The demonstrated developmental shifts suggest that pedagogical approaches to figurative language instruction might benefit from being staged according to children's evolving cognitive capabilities. Early educational interventions could productively leverage hands-on, physically engaged metaphor learning, while later instruction might increasingly incorporate task-type-matched presentation strategies to capitalize on emerging cognitive specializations.

From a theoretical perspective, these results make several important contributions to the field of cognitive linguistics. They provide robust cross-cultural validation for embodied cognition theories while offering novel insights into the developmental timeline of metaphorical thinking. The observed patterns of task-

type sensitivity in particular advance our understanding of how sensory experiences become abstracted into linguistic representations over the course of cognitive maturation.

Future research directions naturally emerge from these findings. Neuroimaging studies could profitably investigate the neural correlates of these developmental shifts, particularly the emerging task-type alignment effect. Cross-cultural comparative work might explore whether the observed patterns represent universal cognitive trajectories or are mediated by linguistic and cultural factors. Longitudinal designs could track individual differences in metaphor acquisition patterns and their relationship to broader cognitive and linguistic development.

Ultimately, this study illuminates the dynamic interplay between physical experience, cognitive development, and linguistic abstraction in shaping how children come to understand and employ figurative language. The findings underscore the profound ways in which our bodily interactions with the world structure even our most abstract linguistic capabilities, while highlighting the importance of considering developmental factors in both the study and instruction of figurative language. These insights not only advance theoretical understanding but also provide practical guidance for educators seeking to nurture figurative language competence during this crucial period of cognitive and linguistic development.

While this study provides valuable insights into embodied metaphor comprehension, several limitations should be acknowledged. First, the geographical scope was restricted to Tehran, which may limit the generalizability of findings to other Persian-speaking populations with diverse dialects or cultural practices. Second, potential confounding variables such as children's cognitive abilities (e.g., IQ), parental education levels, or socioeconomic status were not controlled for, which might influence metaphor comprehension independently of age or gender. Future studies could address these gaps through stratified sampling and inclusion of standardized cognitive measures.

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