

From Piagetian Theories of Cognitive Development to Conceptual Metaphor: A Study on Persian Children

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Abstract

Introduction: This study extends previous research regarding the metaphoric comprehension of normal children, as well as Piagetian theories of cognitive development. The researchers discuss how the understanding of ontological conceptual metaphors improves through age and cognitive development, and helps to expand children's thoughts and knowledge from the world.

Method: The current study is a correlational research. The participants of the study were selected by stratified sampling from different kindergarten and elementary schools. A hundred-twenty-one normal native Persian children with no language and cognitive disabilities with the age range of 5 to 13 participated in the study. To achieve the objectives of this study, an Individual Feature Questionnaire, a Raven IQ Test, a Word Recognition Task, a Semantic Features Task, and an Ontological Conceptual Metaphor Test including simple and complex metaphors were used. Finally, descriptive analysis and Pearson correlation were performed.

Results: The results showed that children start to comprehend abstract concepts and primary ontological metaphors at the age of about five. Both boys and girls have performed better in metaphor comprehension as they grow older. Children, younger than six years old, could not comprehend complex types of metaphor but by growing older, they reached this ability.

Conclusion: Children's metaphorical comprehension improved progressively with age and cognitive development and as the children grew older, they understood more complex types of metaphors.

Keywords: Conceptual Metaphor, Ontological Metaphor, Primary Metaphor, Complex Metaphor, Piaget Theories of Cognitive Development

Introduction

Before the 20th century, a metaphor had been considered as a figure of speech to have rhetorical and lexical meaning [1]. Metaphor as a rhetorical figure of speech used to be defined by the formula "A is B," which expresses one thing in terms of another such as "Achilles is a lion." In this sense, the metaphor formed based on the implicit comparison. In recent years, unlike the traditional point of views which regarded metaphor as a matter of pure literary language and by the emergence of cognitive linguistics in the 1980s, metaphor processing and comprehension has attracted the attention of researchers from different angles and aspects in various fields. Many studies with different perspectives have been done by philosophers, psychologists, linguists, and cognitive scientists on metaphorical issues. In recent studies of cognitive linguistics, there has been a great emphasis on metaphor studies in cognitive models,

communications, and human culture. Most of these recent studies are empirical, and they are applied in the theory of mind and semantics, in particular in the domain of the importance of thought and metaphorical acts in everyday life of the human [2].

If we admit that metaphor might be the natural output of the human mind to find new ways related to the linguistic systems and cognitive activities, it is the time to investigate metaphorical theories based on the underlying nature of the abstract thought and cognitive developments. The researchers in recent studies of metaphor have been involved in the exploration, the preliminary areas of metaphor production, and how metaphors are processed or constructed in the brain.

Cognitive scientists such as Lakoff and Johnson [1], Kövecses [3] and Wray [4] believe that metaphor is a regular activity of thinking and metaphors appear a lot in our everyday language. Lakoff and Johnson [1] introduced metaphor to have a conceptual domain. In the cognitive linguistic perspective, conceptual metaphor is defined as understanding one conceptual domain in terms of another [5]. Lakoff and Johnson [1] defined conceptual metaphors in which one abstract concept from a target domain is perceived by another concept that is more concrete and experiential from the source domain. Therefore, conceptual metaphors include two domains of target and source. The target domain is abstract and cannot be experienced while the source domain is concrete and can be experienced through our bodily interactions. Lakoff and Johnson [1] categorized conceptual metaphors into three overlapping types of metaphor including structural, orientational, and ontological metaphors. In the present study the ontological metaphors which are related to ideas, emotions, activities, and events have been investigated which are basic concepts to sensory-motor neural processing and the embodied cognition since their source domains consist of the emotional and bodily concepts which are included in the first stage of development (sensory-motor, birth to two years old) [6]. Therefore, they may be processed earlier than other types of metaphors since they are embodied through senses at an early age. In ontological metaphors, we perceive an abstract emotion, event, idea, and activates in terms of more concrete substances and entities which can be experienced by our body [1]. One of the primary source domains in metaphors is the human body since it is the most embodied and stable source for humans, while the target domains comprise of abstract concepts like emotions, thoughts, and desires. Kövecses [7] proposed personification to be one of the types of ontological metaphors. Children usually personify things and objects to relate them to their senses and bodies in order to understand it better. In the following examples, ontological metaphors can be seen as "Inflation is an entity":

Inflation is lowering our standard of living.

Inflation is eating up our profits.

If there's much more inflation, we'll never survive.

We need to combat inflation.

Inflation makes me sick.

On the other hand, conceptual metaphors include primary and complex types based on the level of complexity. Grady [8, 9] and Johnson [10] claim that 'primary metaphors' are the types of conceptual metaphors which are grounded in a universal bodily experience and correlates an abstract domain to an everyday subjective and sensory-motor experience, like "warm relation" (Affection is heat sensation). On the other hand, complex metaphors are supposed to be the combination of at least two primary metaphors into a conceptual structure and are indirectly embodied [8, 9, 11]. "Negotiations are on track" (Figure 2), for instance, can be categorized as a complex metaphor since it relies on two primary metaphors: Metaphor 1 (Progressing is heading towards a destination) + Metaphor 2 (Progressing is following a path).

In the following section, we review Piagetian theories of cognitive development and how abstract concepts and reasoning are comprehended and produced by the children according to their age and cognitive development stage, as implied by Piaget & Inhelder [12]. The most influential studies in developmental psychology have been conducted by Piaget [12-14]. According to Piaget's theory, children are active thinkers who are actively engaged with the world around them and endeavor to comprehend their environmental actions and construct a better understanding of the world by passing through several distinct cognitive stages [15]. He claimed that children's knowledge composes of basic units of knowledge named schemas applied to modify past experiences and serve as a basis for conceptualizing new ones. Children transit from one stage of operation to another, and modify their schemas by a joint operation of assimilation and accommodation through adapting to their environment [13]. The assimilation hypothesis can be broadly defined as new learning experiences, which are the integration of external elements into a previously existing knowledge structure [16]. For instance, a child sees a tiger and calls it a cat. On the other hand, accommodation is when the child tries to modify his/her existing schemas with the new information or environmental experience, and a change in the schemas happens. To use the tiger example again, the child learns about the tiger as a cat with stripes and names the cats as tigers. According to Piaget [17], a balance between assimilation and accommodation, which he named equilibrium is necessary to the child, since it restructures the cognitive schemas in the interaction with the environment. Piaget [18] proposed that cognitive development is a constant active process through which the children investigate and experiment with their understanding of how the world works. Piaget [17] introduced four developmental stages in which qualitative changes happen gradually in children's thoughts, and intellectual growth and knowledge are created. The sensorimotor is the first stage, which includes children's movement and sensation, and they discover the world through actions such as grasping, sucking, listening, and looking. He believes that during the final part of this

period, which is from birth to two years old, representational thought emerges. Pre-operational stage (2 to 7 years old) is the next stage, and in this period, the child uses symbols and language as the sign of intelligence. The child's imagination is developed, but they still think non-logical. The next stage is the concrete operational stage (7 to 11 years old) in which the child applies logical and systematic manipulation of symbols to think and talk about concrete objects. Social behaviors emerge, and egocentric thought diminishes. In the last stage, the formal operational stage (11 to adult years), which is more dealt with in the present study, the logical use of symbols occurs to point to abstract ideas and concepts. Adolescents (ages 11 through 18) can understand pure abstractions, such as philosophical and higher mathematical concepts. During this period, children can take into consideration possibilities and hypothetical actions as opposed to real events, which they could have thought about in the previous stages. Individuals improve in comprehension of the higher-order, abstract logic inherent, metaphors, analogies, and proverbs in the middle or end of adolescence. Cometa and Eson [19] have justified in an experiment that understanding of metaphorical utterances develops simultaneously with the formal operational stage. However, in some other studies by Gardner [20], children demonstrated some basic understanding of figurative language in specific conditions and Gentner [21] as well showed that already preschool children could map human body parts onto pictures of trees and mountains. Grzywina [22] has investigated children's with different ages by various experiments related to metaphoric concepts and claimed that children of 4 through 5 could comprehend some specific types of metaphors. Piaget [23] claimed that only 35 percent of teenagers in developed countries could obtain formal operations. Bjorklund and Causey [24] proposed that children's cognitive development is determined by a combination of heredity and environment, and parents can enhance their child's cognitive development and intellectual ability through environmental factors such as learning materials, early age experiences, and reading to and talking with.

The aim of the current study, therefore, is to use experimental data – obtained from the Conceptual Metaphor Test – to investigate four stages of Piagetian cognitive development theories regarding the processing of primary and complex metaphors. In the following section, we analyze how primary and complex ontological conceptual metaphors are comprehended differently according to the age and cognitive development level out of complexities of neural circuitries and cognitive development of children. In other words, the current study explores if the age of ontological conceptual metaphor comprehension in Persian children and Iranian culture is consistent with the age which Piaget has proposed in his developmental stages.

Method

The current study is a correlational research. The variables included age which was controlled and

metaphorical understanding of the children which was checked by the metaphor test.

The target sample of the study included native Persian children of 5 to 13 years old. One-hundred-and-twenty-one kindergarten and elementary school children of the first district of Qom in four categories of age; 5-7, 7.1-9, 9.1-11 and 11.1-13 participated in this study. Stratified sampling was used to obtain a sample which was representative of the population of the study. An announcement for the study was shared in schools and kindergartens of the first district of Qom. The children including both genders (boy and girl) whose parents had agreed to take part in the process of the study were given a questionnaire to fill out. After reviewing the questionnaires, children whose parents announced having normal development and no language and cognitive disorder were visited by a psychologist to check for normal development. Therefore, the children who their normal cognitive and language development were justified by a psychologist were selected to participate in Raven IQ Test. Children with IQ higher than 89 who were regarded as having a normal range of development were investigated by the Metaphor Test. The participants who were considered bilingual or even their parents were bilingual and could understand a second language were eliminated from the study. The children with IQ less than 89 were excluded from the study. The children who had language and developmental disorders like Specific Language Impairment (SLI), Attention Deficit Hyperactivity Disorder (ADHD), Oppositional Defiant Disorder (ODD), and those with hearing loss impairment were also excluded.

Nippold et al. [25] have designed an experiment which considers both their syntactic structure and the semantic area of items used in the metaphors. Two syntactic types of metaphors include predicative and proportional which the former contains one topic and one vehicle (e.g. *The bird was a rainbow*) and it looks like primary metaphor, while the latter contains two topics and two vehicles at an underlying level with one topic not represented at the surface level (e.g. *Tommy was a ship that had no captain*) and implies the structure of complex metaphor. As Nippold et al. also proposed, there was a distinction between perceptual and psychological metaphors. The perceptual metaphors concern visual similarities, while the psychological metaphors focus on emotions, mental states and personality traits both of which take in to consideration the ontological concepts observed in ontological conceptual metaphors. Finally, the test includes four subtests (9 items each) and it is organized according to the complexity level and ontological concepts. The first two groups have tested primary metaphors (perceptual and psychological sequentially) and the second two groups have tested complex metaphors (perceptual and psychological sequentially).

The Standard English Metaphor Test has been chosen, translated, and localized into Persian language. This test has been chosen due to the psychological and perceptual qualities of the items which are included since they are related to ontological and embodied concepts of

the=human mind. The validity of the translated test was justified by four cognitive linguists, cognitive semantics expert, linguist, and neuropsychologist. The reliability of the test was taken in ten children. The test was given to the children twice with one week rest. The analysis revealed reliability of 0.90 in these two sets of data. Table 1 presents the reliability of the test.

Table 1. Reliability statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.90	0.88	36

The following is a sample of a metaphor test question in English. The bird was a rainbow flying in the sky. That means the bird:

- a. was very colorful
- b. was making a nest

Raven's Progressive Matrices (Raven's Matrices IQ Test) is the test of nonverbal intelligence. It is usually a 60-item test designed in measuring the level of both intellectual development and abstract reasoning. It is the most common and popular test administered to groups ranging from 5-year-olds to the elderly. All subjects' IQ have been measured to check whether their IQ is normal or within the normal range. The reliability of the test was taken by a T-Test. The advanced form of Raven's progressive matrices (APM) test had a significant reliability and validity ($P < 0.01$) [26].

An Individual Feature questionnaire was given to the parents to fill out. This test is used to control the developmental, cognitive, and cultural information of the children. The answers of the parents would be corrected by a psychologist based on the children's personal files in the kindergarten and school. Before the experiment was begun, the children had been checked by a Word Recognition Task to see whether they knew the concrete words which were included in each items of metaphor test

to play the role of tenors and vehicles. Then, the researchers checked out how the children were familiar with the semantic features appearing in the metaphor items through the Semantic Features Task. Once the metaphor test was ready, a total number of 121 children were tested for both their IQ and their metaphor comprehension and their voices were recorded. The children were told not to be stressed out since there is no failing or passing based on this test.

The children's answers to the metaphor and IQ test were recorded. Every item of metaphor test has two alternatives to choose. The children were told to choose either A or B alternative, or they could read their answer loudly. The order of metaphoric sentences and their answers was randomized. The time devoted to the answer of every item was 60 seconds so the whole test took about 36 minutes to be done since the number of items were 36. Every item had one score if they were answered correctly. Finally, the whole score of the metaphor test was 36 if the children would have answered to all the questions correctly.

Results

It was expected that the age of the comprehension of abstract thoughts and ontological metaphor comprehension in normal native Persian children would be different from the age which Piaget has demonstrated in his cognitive developmental stages.

In order to evaluate the different parts of this hypothesis, first the descriptive statistics of the groups of data were computed (Tables.).

In order to employ Spearman rho, the linearity of the pairs of variables was investigated, which showed that the relationship between children's age growth and metaphor test scores is almost linear (Figure 1).

Table 2. Descriptive statistics

	Minimum	Maximum	Mean	Std. Deviation	Variance
Gender type	1	2	1.44	0.49	0.24
Children's age	5	13	8.99	2.43	5.93
Metaphor Test	6	34	20.32	6.69	44.88
Children's IQ (Raven)	89	140	108.91	13.75	189.21
Valid N (list wise)					

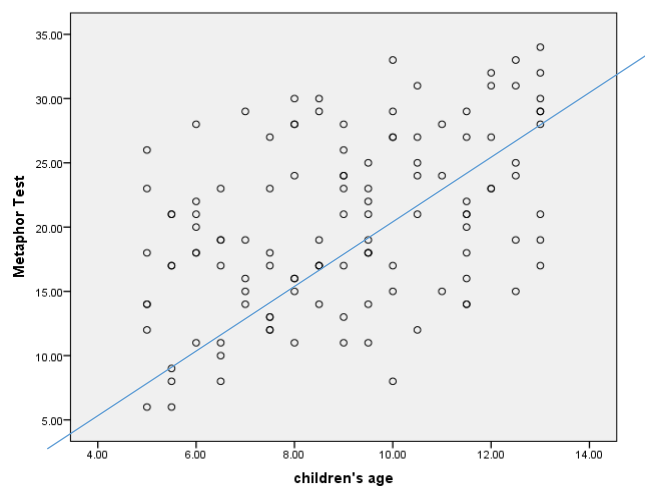


Figure 1. Scatter plot for the relationship between children's age (5-13) and metaphor test scores

Figure 2 presents the data by taking gender differences as one of the factors affecting Metaphor test scores. By the analysis of metaphoric comprehension of female and male children, the researcher concludes that there is a significant difference between the way girls and boys in

different age groups of process metaphors. Boys traverse a more linear understanding by age growth whereas the girls' improvement of metaphor understanding is not so observable as boys and stops or decreases after the age of 11.

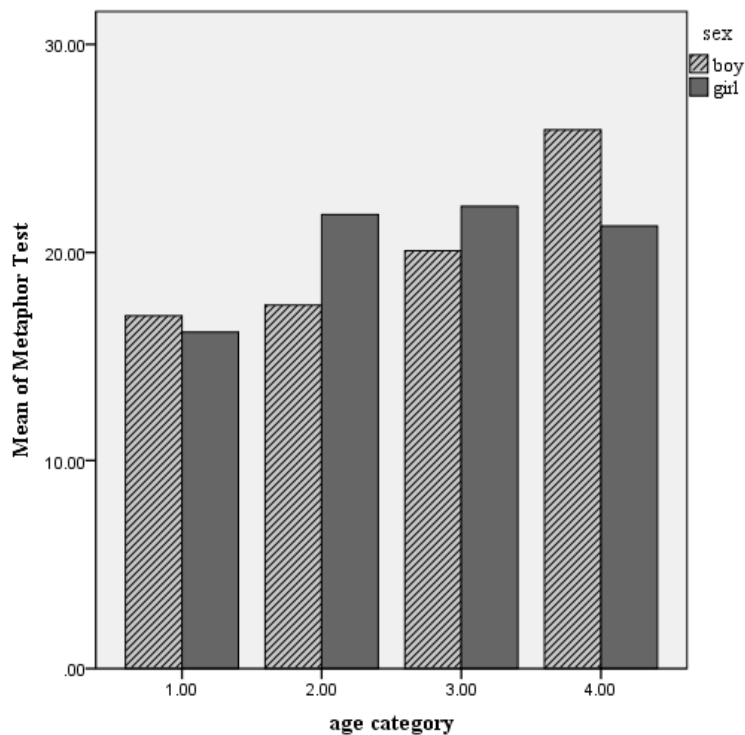


Figure 2. Bar graph for the relationship between gender type (5-13) and metaphor test scores

The first observed assumption of Spearman's rho correlation would test the null hypothesis related to the research question while examining the interaction of age and ontological conceptual metaphor test scores. The responses were analyzed based on the number of metaphor items each child demonstrated an understanding of, as reported in Table 3. The results indicated that there is a significant correlation between the ages in terms of their conceptual metaphor scores; $p < 0.000$, $r = .433$.

Table 3 compares the relationship between children's age categories (5-7, 7.1-9, 9.1-11 and

11.1-13) and metaphor subtest scores. Evidently, there were differences between the means of different age groups in terms of the complexity level of metaphor test; however, the differences in four age groups in primary1 type of metaphors violated the data. In the first age category (5 to 7), the children could have a little understanding of primary1 metaphors while in the next three groups; they performed poorly in the test. Surprisingly, the children of the last age category (11.1 to 13) have not only acted better than the last groups, but they had also scored lower.

Table 3. Categories of age and conceptual metaphor subtest

Age Category	Categories of Metaphor Test				Total
	Primary1	Primary2	Complex1	Complex2	
5 to7 years	5	15	11	2	33
7.1 to 9 years	0	17	9	6	32
9.1 to 11 years	1	9	12	4	26
11.1 to 13 years	0	5	14	11	30
Total	6	46	46	23	121

Discussion

The current study explored the age of metaphor processing and comprehension. These findings enriched our understanding of the early stages of metaphoric and abstract thought comprehension, showing that by five years, and even earlier, infants linked several common abstract thoughts and ideas to their more concrete objects or things. This finding was in contrast with Inhelder and Piaget [12] that regarded the age of 11 and

formal operational stage as the age in which the children use their intelligence and logic to process abstract concepts and metaphors. In another study, Vosniadou and Ortony [27] implied that children comprehend some abstract concepts from the age of 3 or 4 and as their cognitive development improved their metaphoric competency improved. By comparing the other researches' results with this study, it can be assumed that from the time of Piaget up to now, the physical and social

environments, the culture, and the world interactions which are keys to cognitive development have become more complicated, and as the result, the children's brain including cognitive development and executive functions which are an embodied experience has turned to be more complicated and improved. Thus, the children's age of performance and comprehension of higher cortical processes such as conceptual metaphor is younger than what Piaget assumed and it's different from one culture to another.

In this study, by the growth of age, metaphor comprehension improved and children could comprehend more complex metaphors only in older ages. Therefore, cognitive development and language development are correlated and as Piaget implied learners interact with their environment and integrate new knowledge and information into existing knowledge which leads to a state of equilibrium (language is part of this information). On the other hand, Vygotsky [28] maintained that for children, speech is a significant psychological tool to develop the thoughts and tasks which are challenging to promote cognitive development. As a result, it may be argued as the complexity of the items if the metaphor test affected older children's better performance as well as cognitive development.

The beginning age of school and formal learning in Iran is seven. However, the children in the current study could comprehend metaphors before reaching this age. Thus, this study's results supported Lakoff and Johnson's idea [1] that conceptual metaphors are part of our everyday language since early childhood and preschool age (i.e., 5-year old in our research). In addition, the types of conceptual metaphors that are comprehensible at earlier ages are the ontological type that maps the abstract domain to the child's available bodily experiences while interacting with the outside world. The first category of children (five to seven years) were able to comprehend the first group of primary metaphors which are simpler than the three other groups while the other three age categories who were passing their school ages could not. This could be due to the children's stress while testing which the school examination, scoring, teacher and parent expectations brought to the children. The preschool children are free from any worries and anxieties related to testing and face validity of the test since they have not felt the pressures of those above mentioned factors so they may perform better than older adults. Besides, studies [29] have shown that the characteristics of extroversion and introversion play a vital role in anxieties in girls. Therefore, the type of characteristics of the girls needs to be checked. Children of five and six years are more risk-takers in a test than older children since they haven't tasted punishment as the way older children have felt after school. Another reason for this outstanding performance could be related to children's heuristic properties of the mind which have not been conventionalized by any system yet.

Both boys and girls improved in their metaphor test as they grew older but boys had a more linear improvement. The girls' performance in the two middle age categories (7.1 to 9 and 9.1 to 11) was stable and finally at 11.1 to 13

they performed poorly in comparison with both boys and their former girl groups. This unusual performance could be related to synaptic pruning which is a natural process that occurs in the brain between early childhood and the onset of puberty. According to Duffau [30], during synaptic pruning, the brain eliminates extra synapses which allows the neurons to transmit an electrical or chemical signal to another neuron and this state leads the brain areas to have less neural networks, connections, and neural plasticity which are necessary to the improvement of learning mechanism. The girl children of the last age category have performed poorly on the metaphor comprehension because they were at the beginning of the puberty age and they might have more synaptic pruning in their brain which brings about a little malfunction in the cognitive and language development. Finally, the children were not able to comprehend the complex types of metaphors before the "preoperational" stage of Piaget's cognitive development or the age of six in which they were conditioned to learning and memorizing and their view of the world is normally egocentric. Complex types of conceptual metaphor are usually based on mappings of two primary metaphors and egocentric view of children and low function of different components of memory might distort this mapping. The very young children can mostly process and comprehend every conditioned behavior and complex metaphors are not usually conventional to be involved in conditioned behavior.

This study can be used to show how complex the Iranian culture and environment is, and how children's education affects their cognitive development and language growth. Providing a rich training atmosphere by the use of story books, brain exercises, and computer games which [31] helps children reach higher cortical functions and critical thinking earlier. This study is a milestone to know the age of abstract understanding of Persian children to see whether they have any language delay or disorder.

Conclusion

Language and cognition are embedded in our brain. The brain takes its input through the rest of our body which is in contact with the culture and environment. Abstract concepts and conceptual metaphors are part of human beings everyday language as Lakoff and Johnson [1] implied thus their comprehension and production is under the impact of the culture and environment. The brain's neural circuitries and networks which help us conceptualize our world through the interactions with it may be more complicated and developed if the world and culture around is more complicated and developed. This paper presents an experimental research on children's understanding of ontological conceptual metaphors which are mostly based on bodily experiences and concrete substances and entities to process. In this paper, it has been argued that children process and comprehend abstract concepts earlier (age 5) than the age Inhelder and Piaget [12] proposed (age 11) and this level of comprehension is under the impact of cognitive development of the brain which could be different from culture to culture. The more the brain is developed, the

better comprehension of more complex types of metaphor emerges. Thus, neural plasticity can be a great factor affecting higher cortical processing such a metaphoric and abstract language.

For further study, more experimental research (fMRI and Gene candidates) needs to be done on the neural networks of primary and complex ontological conceptual metaphors through their cognitive an age development in the brain of normal and control (children with language disabilities) native Persian children.

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