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LINGUISTICS | RESEARCH ARTICLE

Gestural embodiment of spatial schematic information in motion-based and static space-based metaphors

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Abstract: In this study, we examined the types of gestures that occurred with motion-based, static space-based, static object-based, and static event-based metaphors. A group of participants listened to three short stories and then retold them in front of a camera. The camera could record participants' gestures. Each story contained two metaphors of each type. Our aim was to calculate the frequency of occurrence of metaphoric gestures with these metaphors when participants were retelling the stories. We used a contingency table analysis to make a comparison between the four types of gestures in terms of the number of metaphoric gestures that occurred with them. Results of this analysis showed that the number of metaphoric gestures that occurred with motion-based and static space-based metaphors was significantly higher than the number of metaphoric gestures that occurred with static object-based and static event-based metaphors. Based on these results, it is suggested that metaphoric embodiment of the target of a

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metaphor in terms of its base is dependent on the nature of spatial features of the base. When base of a metaphor includes more spatial schematic information, it is more likely to be realized in metaphoric gestures. This happens for motion-based and static space-based metaphors.

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Keywords: event-based; gesture; metaphor; motion-based; object-based; space-based

1. Introduction

Metaphor and metaphorical embodiment have been the subject of a wide range of empirical studies and theoretical discussions in recent years (e.g., Banaruee et al., 2017; Farsani & Villa-Ochoa, 2022; Khatin-Zadeh et al., 2023; Mishra & Singh, 2010; Onuoha & Uchechukwu, 2022; Rosa & Farsani, 2021; Rosa et al., 2020; Wilson & Gibbs, 2007; Xu et al., 2023). According to Lakoff and Johnson's (1980) conceptual metaphor theory, metaphor is a process through which a concept (often an abstract concept) is understood in terms of another concept (often a concrete concept). The first concept is called the target domain and the second one is called the base domain of the metaphor. The conceptual metaphor theory has been extended and developed by including contextual components that can affect metaphor processing (Kövecses, 2016, 2020, 2021; Zibin, 2021). This developed version of the conceptual metaphor theory has been suggested to explain the actual use of metaphoric language in natural conversations. Metaphorical embodiment is a view that builds on the conceptual metaphor theory. From this perspective, the process of understanding target of a metaphor in terms of its base involves employing the sensorimotor networks that are recruited to process the base (Gallese & Lakoff, 2005). For example, when the metaphor *grasp an idea* is processed, "understanding an idea" (target domain of the metaphor) is described in terms of "grasping an object" (base domain of the metaphor). According to theories of metaphorical embodiment, when this metaphor is processed, sensorimotor networks involved in performing the action of grasping are activated, and the action of grasping is mentally simulated (Gallese & Lakoff, 2005). Mental simulation of the target domain of a metaphor in terms of its base domain has been supported by some behavioral (e.g., Glenberg & Kaschak, 2002; Khatin-Zadeh et al., 2019) and neuroimaging evidence (e.g., Boulenger et al., 2009, 2012). Mental simulation of target domain of a metaphor in terms of its base domain can be realized in a variety of modalities such as language, visuals, gestures, sound, and music. This view has been called the multimodal metaphor theory (e.g., Forceville & Urios-Aparisi, 2009; Zibin & Altakhaineh, 2023). In other words, metaphorical processing can be realized in a variety of perceptual modalities. This means that mental simulations that take place during metaphor processing can be embodied in concretely-perceivable representations. For example, when the metaphorical phrase *grasp an idea* is accompanied by a grasping gesture, the metaphorical conceptualization is embodied in a visually-perceivable gesture.

Metaphorical embodiment of the target domain of a verbal metaphor in terms of its base domain may be realized in gestures that accompany that metaphor. When this happens, the gesture is called "metaphoric gesture" (McNeill, 1992, 2005). For example, when the metaphorical sentence *the prices are going up* is used with an upward hand gesture, the gesture is a metaphoric gesture. In this metaphor, increase in prices is metaphorically described in terms of an upward movement, and an upward gesture is used to depict the base of the metaphor. Hostetter and Alibali (2008, 2018) argue that the occurrence of a metaphoric gesture with a metaphor that refers to a metaphoric action shows that the metaphoric action is mentally simulated and realized in body gestures. Gestural embodiment of a mental metaphoric simulation is a metaphoric gesture. When the mental simulation of a literal sentence is realized in a gesture, it is called an iconic gesture. In the following section, we review some empirical studies that have examined metaphorical embodiment of concepts in gestures.

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2. Literature review of empirical studies on metaphorical embodiment

In one of the earliest studies on metaphorical embodiment, Wilson and Gibbs (2007) examined the speed of understanding of a set of metaphors in two different priming conditions. In each item of this study, participants either performed or imagined a body movement and then immediately read a metaphor. The body movement depicted the base domain of the subsequent metaphor. Results of this study showed that in both priming conditions, the process of understanding the metaphors was facilitated, suggesting that metaphorical actions are mentally simulated during metaphor comprehension. A recent study (Khatin-Zadeh, 2023) examined the speed of understanding a set of metaphors in three different conditions: congruent gesture-prime conditions, opposite gesture-prime conditions, and no-prime conditions. In the first set of conditions, participants saw the gestural representation of a metaphor schema and then read that metaphor. In the second set of conditions, participants saw a gesture that was opposite to the gestural representation of a metaphor schema and then read that metaphor. The results showed that the fastest and the best interpretations had been provided in congruent gesture-prime conditions. Another related study (Khatin-Zadeh et al., 2023) examined the process of understanding a set of metaphors in congruent gesture-prime, incongruent gesture-prime, and no-prime conditions. In the first set of conditions, participants saw a gesture that was compatible with the schema of the subsequent metaphor; in the second set of conditions, participants saw a gesture that was not compatible with the schema of the subsequent metaphor. The results showed that response times of acceptability judgments were shorter in congruent gesture-prime conditions. Such findings again suggest that metaphorical actions are mentally simulated during metaphor processing, and this simulation can be realized in metaphoric gestures.

Mental simulation of metaphorical actions has been supported not only by priming studies but also by some studies conducted on the comprehension of metaphor in discourse. In one of these studies (Horchak et al., 2014), a group of participants read a text that included some sentences referring to forward metaphoric actions. In one test, when participants were reading the sentences, they made movements that were compatible or incompatible with metaphoric actions. In another test, participants' body postures were compatible or incompatible with the metaphoric actions. Participants' comprehension of the discourse was tested in both sets of conditions. Results of both tests showed that in compatible conditions, participants' comprehension of discourse was better. This again supported the idea of mental simulation of metaphoric actions.

A question that is raised here is how type of a metaphor can affect the process of mental simulation. To answer this question, a classification of metaphors that categorizes metaphors into four types has been suggested (Khatin-Zadeh et al., 2022). In the following section, we look at this classification and review two studies that have used it to investigate the process of mental and gestural simulation of metaphorical sentences.

3. A classification of metaphors

Depending on a variety of criteria, metaphors can be classified into various categories. Khatin-Zadeh et al. (2022) have suggested a specific classification for studying the process of mental simulation of metaphoric actions. This classification is based on whether the base of the metaphor is a motion or a static concept. Based on this classification, metaphors are categorized into four types: motion-based, static space-based, static object-based, and static event-based. A motion-based metaphor describes a concept (target of the metaphor) in terms of a movement. The metaphorical sentence *time is flying* describes the abstract concept of "time" as a moving object. Similarly, the metaphorical sentences *prices are going up* is another example of motion-based metaphors that describes "the increase in prices" as an upward movement. Static space-based metaphor is a metaphor that describes a concept in terms of a location in the three-dimensional space. The metaphorical sentence *rich people have high social positions* describes "social status" in terms of a high location in the space. This metaphorical description includes a static spatial location and does not involve any movement. A static object-based metaphor describes a concept in terms of a non-moving object or a non-motion feature of an object (size. shape, color, etc.). The

metaphorical sentence *this conflict is a big hurdle for expanding relations* is an example of such metaphors. A static event-based metaphor is a metaphor that describes a concept in terms of a non-motion event. The metaphorical sentence *I got my finger badly burned in the stock exchange* is an example of static event-based metaphors that describes "losing money" as the burning of a finger.

In one study that used this classification of metaphors (Khatin-Zadeh et al., 2022), metaphoric and beat gestures that occurred with the four types of metaphors in a story retelling setting were examined. The results showed that metaphoric gestures occurred most frequently with static space-based metaphors, while beat gestures occurred most frequently with static event-based metaphors. In another study, Khatin-Zadeh et al. (2022) developed this classification of metaphors and introduced a parallel classification for literal sentences. The results showed that event-based metaphorical sentences were accompanied by the smallest number of metaphoric gestures and event-based literal sentences were accompanied by the smallest number of iconic gestures. These iconic gestures represented the literal meanings of event-based literal sentences. Interestingly, results of this study showed a significant similarity between parallel metaphorical and literal categories in terms of the number of gestures that were used with them.

In our study, our goal was to develop our past studies (Khatin-Zadeh et al., 2022, 2022) and conduct a deeper examination on metaphoric gestures that occur with the four types of metaphors. Similar to our previous studies, we designed a story retelling setting and asked a group of participants to retell a set of short stories in front of a camera that recorded their gestures. We used the same stories that had been used as stimuli in our previous studies. Our aim was to find out what type of spatial features of the base domain of a metaphor were mostly described in metaphoric gestures that occurred with the four types of metaphors. Specifically, we focused on spatial schematic and spatial non-schematic features of the base domains of motion-based and static-based metaphors. Since the bases of motion-based and static space-based metaphors contain more spatial schematic information, we hypothesized that these two types of metaphors occur with a larger number of metaphoric gestures, compared to static object-based and static event-based metaphors. In the following section, we describe the method of our study.

4. Method

In this study, we used a story retelling setting to collect the data. We asked a group of participants to listen to a set of stories and then retell them in front of a camera. Our aim was to analyze the types of gestures that occurred with various types of metaphors.

4.1. Participants

Thirty-one students were selected from language learners in Bartar Language Academy, Bandar Abbas, Iran. These participants were selected by convenient sampling from a larger group of students who were available in the academy. They were 18–33 years old, including 19 females and 12 males. All participants were Persian native speakers. They participated voluntarily and gave their written informed consent. Before conducting the study, they were checked to make sure that they did not have any mental, hearing, and language problems. This was done to make sure that they would be able to perform the task in the story retelling session. As a reward for their participation in the study, they received gift cards and tuition fee discounts to take part in English courses in Bartar Language Academy. The study was conducted according to the declaration of Helsinki (World Medical Association, 2013).

4.2. Materials

Three short Persian audio stories were used in this study. These stories were modified versions of the same stories that had been used in our past studies (Khatin-Zadeh et al., 2022, 2022). The audio file of each story was 4–5 minutes and included about 450–500 words. The first story was about a poor child who later became a successful and rich person. The second story was about a low-level laborer who became the owner of a large factory. The third story was about the happy

consequences of a bad event in the life of an individual. Each story had eight metaphorical sentences, including two metaphors of each type (motion-based metaphors, static space-based metaphors, static object-based metaphors, and static event-based metaphors). The order of occurrence of various types of metaphors was random across the three stories. In each story, only eight metaphors were included. The English translations of metaphors have been given in the Appendix.

4.3. Procedure

Before conducting the main session of story retelling for collecting the data, participants of the study attended a training session. The aim was to familiarize them with the procedure of the main session of the study. In this training session, a sample story was given to the participants. Then, they were asked to retell it in front of a camera. In the training session and before conducting the main session of the study, purpose of the study was not revealed to the participants. This was done to prevent any kind of impact on participants' performance during retelling the stories, as knowing purpose of the study could affect their production of gestures. At the beginning of the main session of the study and before asking participants to retell the stories, they were provided with detailed oral instructions to make sure that they knew how to perform. For retelling each story, participants stood in front of a camera that had been installed 1.5 meter away. They listened to the first audio story and then retold it in their own language. They had 5 minutes to retell the story. The camera could record the gestures that were produced by participants during retelling the stories. The same procedure was used for the second and third stories. Each participant listened to and retold the three stories. Order of presenting and retelling the stories was the same for all participants.

4.4. Data analysis procedure

We analyzed the gestures that occurred with various types of metaphors. In this analysis, types of gestures that occurred with each type of metaphor (motion-based metaphors, static space-based metaphors, static object-based metaphors, and static event-based metaphors) were determined. The aim was to obtain the number of metaphoric gestures that occurred with each type of metaphor. A metaphoric gesture was defined as a body movement that occurred with a verbal metaphor to express the metaphorical meaning. The coding of gestures was done by two independent coders who were not involved in the study. This was done to reduce the probability of any bias in the coding of data. Both coders were Persian native speakers. The number of each type of metaphor produced during retelling the stories and also the number of metaphoric gestures that occurred with each type of metaphor were obtained. Inter-coder reliability was calculated to make sure that the process of coding gestures had an acceptable level of reliability. This was done by calculating the percentage of cases that the judgments of the two coders were consistent with one another. Then, a contingency table analysis was used to examine the frequency of co-occurrence of metaphoric gestures with each type of metaphor. The aim of this analysis was to find out whether there was a significant difference between the four types of metaphors in terms of the numbers of metaphoric gestures that occurred with them.

5. Results

The judgments of the two coders on the types of gestures that occurred with each type of metaphorical sentences were compared. In 91% of judgments, the two coders had made similar judgments, which was an acceptable rate of reliability. For those cases that the coders had made dissimilar judgments, one of the researchers of the study made the final judgment.

The sums of produced metaphors during retelling the stories have been given in Table 1. The sums are shown separately for each type of metaphor. Also, the number of metaphoric gestures that occurred with each type of metaphor and the proportion of each type of metaphor that was accompanied by metaphoric gestures have been given.

Table 1. The number of each type of metaphor and the number of metaphoric gestures that occurred with each type of metaphor

	Motion-based metaphor	Static space-based metaphor	Static object-based metaphor	Static event-based metaphor
Number of produced metaphors	118	98	131	106
Number of produced metaphoric gestures	82	73	51	39
Proportion of metaphors accompanied by gestures	69.4%	74.4%	38.9%	36.7%

A 2×4 contingency table analysis was used to make a comparison between the frequencies of metaphoric gestures that occurred with the four types of metaphors (motion-based, static space-based, static object-based, and static event-based). Results of this analysis showed a significant association between the frequency of metaphoric gestures and type of metaphor (χ^2 (3, n = 698) = 15.6668, p = .001327). In addition to this test, six 2×2 contingency table analyses was used to make comparisons between the frequencies of metaphoric gestures that occurred with every two types of metaphors (pair comparisons). Results of these analyses along with the values of proportions that have been given in Table 1 showed that the number of metaphoric gestures that occurred with motion-based and static space-based metaphors was significantly higher than the number of metaphoric gestures that occurred with static object-based and static event-based metaphors. However, there was not a significant difference between motion-based and static space-based metaphors in terms of the number of co-occurring metaphoric gestures. Also, there was not a significant difference between static object-based and static event-based metaphors in terms of the number of co-occurring gestures.

6. Discussion

Results of this study showed that participants used a significant number of metaphoric gestures with motion-based, static space-based, static object-based, and static event-based metaphors. Importantly, the number of metaphoric gestures that occurred with motion-based and static space-based metaphors was significantly higher than the number of metaphoric gestures that occurred with static object-based and static event-based metaphors. However, there was not a significant difference between motion-based and static space-based metaphors in terms of the number of co-occurring metaphoric gestures. These suggest that the way that a metaphorical conceptualization is mentally simulated and embodied in a gestural mode is dependent on the type of the metaphor. In order to explain these results, we have to look at the features of motion-based and static space-based metaphors. In these two types of metaphors, spatial elements play a central role, as spatial features constitute the key part of semantic content of the bases of these metaphors. Spatial features are strongly visual. People often use gestures when they talk about spatial concepts because gestures can present a visual description of such concepts. In fact, in many cases, a gesture can be a more powerful tool than speech to express spatial information. Sometimes, spatial information that is expressed by several sentences can be encoded in a single gesture and expressed in a much easier and more understandable way (e.g., Alibali & Nathan, 2012; Khatin-Zadeh et al., 2022, 2022; Wesp et al., 2001). This is why motion-based and static space-based metaphors are accompanied by a significant number of metaphoric gestures.

One important point about the results of our study was that there was not a significant difference between the numbers of metaphoric gestures that occurred with motion-based and static space-based metaphors. This suggests that when gestures occur with motion-based and static space-based

metaphors, some static spatial features (but not motion-related spatial features) may play a central role. Both motion-based and static space-based metaphors involve spatial elements. Since the data of our study showed that there was not a significant difference between these two categories of metaphors in terms of co-occurring metaphoric gestures, it can be concluded that being spatial is the key reason behind the higher use of metaphoric gestures with them. In other words, the data of our study suggested that the feature of movement did not have any significant impact on the use of metaphoric gestures with motion-based metaphors. The key feature is *being spatial*, which is shared by both motion-based and static space-based metaphors. An example can make the point clearer. The metaphorical sentence *he rose up in the hierarchy of the organization* is a motion-based metaphor. The key semantic feature of the base of this metaphor is "upward movement". But, this movement takes place in the three dimensional space. Therefore, spatial features play a role in this metaphor. On the other hand, the metaphorical sentence *she is in a high position in our company* is a static space-based metaphor. Base of this metaphor is a spatial concept but it does not include any moving element. The data of our study showed that the number of metaphoric gestures that occurred with these two metaphors did not differ significantly. This means that the feature of being spatial, which is shared by both metaphors, is the primary reason behind the high use of metaphoric gestures with these metaphors.

A question that may be raised here is that even static object-based and static event-based metaphors may contain some spatial elements. For example, when the relationship between two individuals is metaphorically described in terms of an object that connects two other objects, the abstract concept of social relationship is understood as a physical object. This physical object has a size. This means that this object, which serves as the base of the metaphor, has some degree of spatial features. A question that is raised here is that why this metaphor, which has a base with some degree of spatial features is accompanied by a smaller number of gestures compared to motion-based metaphors and static space-based metaphors. In order to answer this question, it should be noted that motion-based and static space-based metaphors are often more schematic than static object-based and static event-based metaphors. In other words, in motion-based and static space-based metaphors, spatial relations between a set of objects constitute the key feature of the base and the meaning of the metaphor. For example, the metaphorical sentence *the country entered a new stage of its history* describes the start of a new era in the history of a country in terms of the entrance of an object into a location. This metaphor is highly schematic (Khatin-Zadeh et al., 2023). The schema of this metaphor includes an object that enters an area. This schema can easily be depicted by a metaphoric gesture. In addition to this schema, there are some spatial non-schematic features in this metaphorical description, such as size and shape of the moving object. These spatial non-schematic features often are not described by metaphoric gestures, as they are related to less important features of the base of the metaphor. The key feature, which is at the center of attention, is described by the schema of the metaphor and a gesture that depicts the metaphor schema. Static object-based and static event-based metaphors usually do not have a metaphor schema. Even if these metaphors may have some spatial features, these features are non-schematic and are less likely to be described by metaphoric gestures.

Based on the above discussion, it can be suggested that spatial features of the base of a metaphor can be divided into two categories: spatial schematic features and spatial non-schematic features. Schematic features are at a higher-level and constitute the core meaning of the metaphor. Non-schematic features are at a lower-level and are related to details of spatial features. Motion-based metaphors and static space-based metaphors include primarily spatial schematic features. These features can easily be shown by metaphoric gestures. These features contain the key parts of metaphorical meaning of motion-based and static space-based metaphors. These two categories of metaphors may also include non-schematic features. But, these features do not play a central role in the semantic content of the base of the metaphor and are less likely to be shown by metaphoric gestures. On the other hand, bases of static object-based and static event-based metaphors often do not include any schematic features. They may include some degree of spatial non-schematic features. To summarize, having spatial schematic and/or non-schematic features is the key factor affecting type of gestures that occur with motion-based, static space-based, static object-based, and static event-based metaphors.

7. Limitations of the study

In this study, we were faced with some limitations. Firstly, because of the logistical issues (difficulty of access to the participants, not having enough equipment, etc.), we had access to a limited number of Persian native speakers. Therefore, we conducted our study on a relatively small number of participants. Conducting this study on a larger number of participants from a variety of linguistic and cultural backgrounds could have produced more reliable results. Secondly, this study was conducted in a controlled story-telling setting. The conditions of the study might have affected the performance of the participants. If the data had been collected in more natural conditions, the obtained results could have been more reliable. Considering such limitations that might have affected the scope of interpretation of our study, we suggest that similar studies be conducted on larger populations from a variety of linguistic backgrounds in more natural conditions. Conducting larger studies in such conditions can produce more reliable and more accurate results.

8. Conclusion

Based on the results of this study, it can be suggested that the occurrence of a metaphoric gesture with a metaphor is dependent on the type of spatial information that is encoded in the base domain of the metaphor. If base domain of a metaphor has a schematic nature, the spatial schematic information can play a key role in the metaphorical meaning, and the metaphor is more likely to be accompanied by a metaphoric gesture that depicts metaphor schema and schematic information. This is the case with motion-based and static space-based metaphors. Since these two types of metaphors often have a spatial schematic nature, their semantic contents and metaphorical meanings can easily be expressed by metaphoric gestures. That is why these two types of metaphor are accompanied by a larger number of metaphoric gestures. On the other hand, base domains of motion-based and static space-based metaphors often do not include a schema and spatial schematic information. Even when they contain spatial information, this information is non-schematic. Non-schematic information does not play a key role in the metaphorical meaning. This type of information often is not expressed by a gesture as it is not at the focus of attention when a metaphor is used. This implies that metaphors are embodied in a variety of modalities. But, metaphorically-relevant features are more likely to be embodied in a gestural format; on the other hand, metaphorically-irrelevant features are less likely to be realized in gestures. In this study, we specifically focused on metaphoric gestures. Examining the relationship between non-metaphoric gestures (such as beat gestures and pointing gestures) and spatial information is a question that can be investigated in future studies.

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Data availability statement

The data are attached as supplementary materials.

Ethics approval

The study was carried out according to the declaration of Helsinki (World Medical Association, 2013) and was approved by ethical committee of Bartar Language Academy.

Disclosure statement

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Appendix

List of English translations of metaphors used in the stories. These are the same metaphors that were used in Khatin-Zadeh et al. (2022).

Motion-based metaphors

(1) He rose up in the hierarchy of the organization
(2) People's morale went up
(3) Time is moving fast
(4) She fell down into a state of depression
(5) We are approaching Christmas holidays
(6) She left this world at a young age

Static space-based metaphors

(1) She is in a high position in our company
(2) They are living at the lowest level of society
(3) They were looking at the situation from two different perspectives
(4) His friend thought highly of him
(5) A large part of society is living under the line of poverty
(6) His book stands among top novels

Static object-based metaphors

(1) He had a heavy influence on his friends
(2) A writer's pen is stronger than a dictator's sword
(3) He is living in a sea of problems
(4) Your advice is a lighthouse for me
(5) His father's way of life was a lighthouse for him
(6) Strict regulations are a big obstacle for our company

Static event-based metaphors

(1) He was simmering in anger
(2) The man was drowned in his thoughts
(3) She managed to conquer her illness
(4) After hearing the bad news, he was destroyed
(5) He is now in peace
(6) His words revolutionized my way of thinking