A Comparison of Temporal Gestures According to the Language Used and L2 Proficiency in L1- Turkish and L2- English Bilinguals

By

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STATEMENT OF AUTHORSHIP

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ABSTRACT

A Comparison of Temporal Gestures According to the Language Used and L2 Proficiency in L1-Turkish and L2-English Bilinguals

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We use space to think and talk about time, which is evident in our everyday language with spatial metaphors of time. Along with verbal expressions, our gestures reflect how we conceptualize time spatially, sometimes revealing the patterns not present in language. Previous research investigated the role of conventionality in metaphor processing in both monolingual and bilingual contexts. However, no study compared the same spatial metaphors of time in bilingual context as how we process them. This study examines the differences in processing and gesturing the same metaphors in L1-Turkish and L2-English bilinguals. We asked our participants (n=27) to elaborate on literal and metaphorical sentences with the same spatial words. We found that individuals produced more temporal gestures while explaining L2 metaphors compared to L1 metaphors with more proficient L2 speakers producing fewer temporal gestures especially for the most conventional sentences. Our results also revealed that L2 but not L1 metaphors elicited more bimanual gestures than their literal counterparts. Participants used the lateral and sagittal axes equally frequently while producing temporal gestures and their beat gestures' directions mostly conformed to the metaphorical mappings they expressed in speech. These findings hint at the role of conventionality of metaphors in bilingual metaphor processing and how we produce temporal gestures as we talk about time in terms of space. This research sparks a new line of research, which studies different theories of metaphors together to explore how we process metaphors and produce temporal gestures.

Keywords: metaphor, time, temporal gestures, bilingualism

ÖZETÇE

Türkçe ve İngilizce Konuşan İki Dillilerde Zamansal Jestlerin Kullanılan Dile ve İngilizce Yeterliliğine Göre Karşılaştırılması

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Zaman hakkında düşünmek ve konuşmak için uzamı kullanırız. Bu durum günlük dilde kullandığımız zamanın uzamsal metaforlarında görülebilir. Sözlü ifadelerimizin yanında jestlerimiz de zamanı nasıl kavramsallaştırdığımızı bazen sözlü dilde görülmeyen örneklerle gösterir. Geçmiş araştırmalar metaforların alışılmışlık derecesinin metaforları işlemedeki rolünü tek dilli ve iki dilli bağlamlarda incelemişlerdir. Ancak hiçbir çalışma zamanın uzamsal metaforlarını nasıl işlediğimizi iki dilli bir bağlamda araştırmamıştır. Bu araştırma aynı metaforları birinci ve ikinci dilde işleme arasındaki farkları ve nasıl zamansal jestler yaptığımızı Türkçe-İngilizce iki dilli bir örneklem grubunda incelemektedir. Katılımcılarımızdan (n=27) aynı uzamsal sözcüklerin kullanıldığı gerçek anlamlı cümleleri ve metaforları açıklamalarını istedik. Katılımcıların metaforları açıklarken ikinci dilde birinci dile kıyasla daha fazla zamansal jest yaptıklarını, özellikle alışılmışlık derecesi en yüksek metaforlarda ikinci dil yeterliliği yüksek olanların ise daha az zamansal jest yaptığını bulduk. Sonuçlar ayrıca birinci değil ikinci dildeki metaforların daha fazla çift el kullanılan jest yaptırdığını gösterdi. Katılımcılarımız sagital ve lateral eksenleri zamansal jest yaparken eşit sıklıkta kullandı ve katılımcılarımızın ritim jestlerinin yönlerinin anlattıkları metaforlarla iki dilde de tutarlı olduğunu bulduk. Bu bulgular iki dilli metafor işlemede ve zaman hakkında uzamsal sözcükler kullanarak konuşurken yaptığımız zamansal jestlerde metaforların alışılmışlık derecelerinin rolü olduğuna işaret etmektedir. Bu çalışma ayrıca metaforları işleme yöntemlerimizi ve zamansal jestleri nasıl yaptığımızı keşfetmek için değişik metafor teorilerinin bir arada değerlendirilebileceği yeni bir araştırma alanını başlatmaktadır.

Anahtar sözcükler: metafor, zaman, zamansal jestler, iki dillilik

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INTRODUCTION

As entities with a physical structure, we occupy some area in space. This space not only contains us, but also helps us think about abstract concepts such as time or goodness (Lakoff & Johnson, 1980). The support of space in thinking about time can be observed in the examples of everyday language like “Let’s put everything behind us” as past is thought to be located behind the observer. This spatial conceptualization of time stems from spatial metaphors of time. These mappings of space on time enable us to think and communicate about time more easily. Languages share similar spatial metaphors for time. Yet, the same metaphors can be processed differently if participants see and hear them in a language different than their native language (Jankowiak et al., 2017). This processing difference can be a result of the decreased sensitivity to the same metaphors’ conventionality. A metaphor becomes conventionalized through its use over time. The processing of a metaphor, then, becomes more of an access to the stored meanings of its terms instead of mapping the terms in the metaphor on each other (Bowdle & Gentner, 2005). How do speakers process spatial metaphors of time in their first and second languages in relation to conventionalizing the metaphors? Speakers use gestures to activate, manipulate, package, and explore spatial information (Kita, Alibali, & Chu, 2017). Similarly, space-time mappings are not only visible in the language. People also use gestures when talking about time such as pointing to locations (Calbris, 1990), and placing temporal events with their hands accordingly with their metaphorical locations (Cooperrider & Nunez, 2009). How do people gesture and reflect about spatial metaphors in their first and second languages?

This study investigated temporal gestures in L1-Turkish (first language) speakers when they talked about spatial metaphors of time in L1-Turkish and L2-English (second language). We asked whether processing differences arising from the conventionality of the same metaphors in different languages were observable in gestures when one tried to explain the meanings of metaphors. The examination of L1-Turkish and L2-English speakers gave us an ideal opportunity to observe these differences as the two languages share many spatial metaphors of time (Ördem, 2014). Based on the earlier work on bilingual metaphor processing, we expected a difference between L1 and L2 metaphor processing as a function of language. Specifically, the metaphors in L2 would be processed more like novel as opposed to conventional metaphors, compared to the metaphors in L1. Moreover, we predicted that L2 proficiency, would play a role in L2 metaphor processing. The English metaphors would be less conventional for the participants with lower L2 proficiency. Thus, the decreased conventionality would be reflected on the processing of metaphors; as novel metaphors are processed by mapping the base term onto the target term, whereas the processing of conventional metaphors involves accessing the stored meanings of terms instead of online mapping. This reflection would be evident in the gesture frequency and type as less conventional metaphors may have required more online mappings to be carried out.

1.1 Metaphors

The English word ‘space’ seems to derive from the Latin word ‘spatium,’ which means ‘room, area, distance’ as well as ‘stretch of time’ (Space (n.), (n.d.), Online Etymology Dictionary). The temporal sense of this word calls for attention as space and time are different domains of experience. Space is a concrete entity that surrounds us.

Time, on the other hand, is an abstract concept, of which we can only observe the effects. However, these two domains are linked in our minds, as evident from the definition of ‘spatium.’ This definition is not the only example of this connection. In our lives, we often have *long meetings*, and we must do some work *ahead of time*. These connections between the abstract concepts and concrete entities are called metaphors (Lakoff, 1993).

The prominent theory about metaphors is the Conceptual Metaphor Theory - CMT (Lakoff & Johnson, 1980; 1999). This theory makes a distinction between the sensible, concrete entities, and the abstract concepts we cannot perceive with our senses. Thus, the central tenet of this theory is that we map concrete entities onto abstract concepts to think about and communicate these concepts more effectively. One of the most ubiquitous abstract concepts is time. We need to have a firm grasp of this concept to orient our lives. We have invented many mappings in which we map concrete entities, or some properties of them, onto the abstract concept of time to solve this problem. One widely known mapping of this kind is the ‘TIME is MONEY’ metaphor. To illustrate, someone wastes our time, although it is not something that people waste in the literal sense. In the same vein, this person would cost us time. Again, time is not, in the literal sense, something that someone can cost us.

Metaphors have two terms. The *target* term is the abstract element of the metaphor, whereas the *base* term is the concrete part to which we liken the abstract element (Gentner & Wolff, 1997). In the example of ‘Time is money,’ *money* is the base, and *time* is the target of this metaphor. Metaphor comprehension research mostly focuses on how conventional a metaphor is, and whether metaphors involve comparing two terms or categorizing one term in terms of each other. The conventionality and comparison/categorization approaches center on the conventionality of the relationship between the base and target term, and of the terms themselves. For example, the Graded Salience Hypothesis (Giora, 1997) claims that we process the more salient (familiar, conventional, frequent) meanings first in an easier way. Moreover, if a number of expressions are different from each other in terms of salience, they require different processes to be understood. From a different perspective, The Property Attribution Model (Glucksberg, McGlone, & Manfredi, 1997) suggests that the base term of a metaphor provides categories by which we classify target terms. These target terms provide some dimensions according to which the categories may apply to them. Building on these views and Gentner's earlier works (Gentner, 1983; Gentner & Wolff, 1997), the Career of Metaphor Model (Bowdle & Gentner, 2005) makes a distinction between novel and conventional metaphors. A novel metaphor has a base term with no conventionalized metaphorical meaning and is not a common match with its target. For example, 'Science is a glacier' is a novel metaphor in that the base term *glacier* does not have a conventionalized meaning such as 'anything that progresses slowly but steadily' and we do not often match it with the target term *science* (Bowdle & Gentner, 2005). Therefore, it meets both conditions for a metaphor to be novel. 'Time flies,' on the other hand, is a conventional metaphor as it satisfies these conditions. The model proposes that we process novel and conventional metaphors in different ways. Processing of novel metaphors involves comparing and mapping base and target terms when we comprehend them. In contrast, for the conventional metaphors, the process turns into accessing the stored meanings of terms. Moreover, as a metaphor gets conventionalized, meaning of the base term transforms into a more general concept (e.g., 'Anything that provides a plan' for 'A blueprint'). This means that one thinks about a more general concept than a concrete blueprint while making sense of the metaphor. In terms of the spatial metaphors of time, if we were to comprehend a more novel spatial metaphor of time than ‘Time flies,’ we would try to establish more correspondences (i.e., mappings) between space and time to make sense of that metaphor.

As illustrated in the above examples, one common family of metaphors is the *spatial* metaphors of time. According to the CMT, “we understand time in terms of things (i.e., entities and locations)” (Lakoff, 1993, p.11). We conceptualize the passing of time as motion. For example, we say things like ‘That time has passed,’ conceptualizing time as a moving entity. Similarly, we think of temporal concepts like ‘past’ and ‘future’ as being behind and in front of us. As a result, we ‘leave everything behind’ and ‘move on.’ Last, temporal events seem to have physical dimensions in our minds, just like entities. That is why boring classes are experienced to be ‘longer’ than the fun classes.

The spatial metaphors of time are not limited to these examples. We conceptualize temporally ordered events as following each other. For instance, we have meetings coming *after* lunch at work. We also think of temporal events as having a spatial relation with us (i.e., the observer). For example, a final exam can *rush toward* us, like an object possessing motion. In contrast, we can *approach* the final exam week. This time, we can move, whereas the temporal event is again thought of as an object, albeit a stationary one. These two construals of time are called the moving-ego and moving-time perspectives, respectively (Clark, 1973). These perspectives are related to our conceptualization of time (McGlone & Harding, 1998; Gentner, Imai, & Boroditsky, 2002). For example, McGlone and Harding (1998) asked participants to answer temporal questions written either with the moving-ego perspective or moving-time perspective. Then, participants received an ambiguous temporal statement such as “The meeting originally scheduled for next Wednesday has been moved forward two days." Participants who had answered moving-ego questions before the statement were more likely to think the meeting would be held on Friday, whereas the moving-time group opted for Monday, consistent with the moving-ego and moving-time perspectives, respectively. This shows that we do not only speak according to these perspectives, but we think about time in terms of them. Moreover, the thinking patterns elicited by a temporal perspective is not a momentary phenomenon. Instead, it may affect the subsequent judgments such as temporal ambiguity resolution.

Taken together, we use spatial metaphors to think about and understand time. We attribute the qualities of spatial objects to the temporal events, or even time itself. While doing this, we do not leave ourselves out of the equation. We place ourselves in our mappings of space onto time so that we can better think about and communicate the relation of time with ourselves, along with the relations of temporal events with each other. Metaphors have mostly been studied in English from the perspective of production and comprehension. Do different languages have different metaphors even though speakers of different languages have similar bodies to interact with the space? What happens when one learns a language that has different metaphors than one's first language? Or do we process the same metaphors similarly when they are expressed in different languages?

Research on metaphors outside English and in a bilingual context has looked at spatial metaphors of time more extensively compared to the other types of metaphors. Lakoff and Johnson (1980, 1999) claimed that the practice of using space to think about time is essential for understanding it. In line with this, no language throughout the world has been reported to be devoid of spatial metaphors of time (Haspelmath, 1997). Although the overarching practice is the same, some languages differ in how they use space to conceptualize time. For example, Boroditsky (2001) found that Mandarin -

English bilinguals think in terms of vertical spatial metaphors of time with earlier events are thought of as up and later events as down – following their writing patterns and linguistic expressions, unlike the front/back metaphors that are common in English. This shows that Mandarin – English bilinguals have a different mapping of space onto time, while they still use space to make sense of it. However, Chen (2007) failed to replicate these findings and showed that Mandarin has as much front/back metaphors of time as it has the vertical metaphors. This debate shows that different languages can use space differently while mapping it onto time, and two different mappings of space onto time can take place in a single mind. Another study reported that a tribe of the Andes called Aymara has the reverse front/back mapping of time in which they place the future behind and past in front of them (Nuñez & Sweetser, 2006). Moreover, with the increased exposure to Spanish in their formal education setting, the young Aymara-Spanish bilinguals adopted the 'Spanish' way of mapping space onto time by placing future in front of them with gestures.

These findings show that although all languages throughout the world seem to use space to think about time, some languages differ from the usual practice in their way of using it. The findings also indicate that learning a second language can introduce new spatial mappings of time in our minds. At this point, metaphor comprehension studies in the bilingual context can provide us with some insights as the production aspect hints at some cross-linguistic differences.

Metaphor comprehension studies have approached the topic from a different perspective and studied the comprehension of the same metaphors in L1 and L2 (Chen, Peng, & Zhao, 2013; Jankowiak et al., 2017; Özçalışkan, 2004). For example, Chen et al. (2013) presented Chinese-English bilinguals with metaphors and literal sentences in L1 and L2 in an event-related potential (ERP) experiment. The results showed that different mechanisms came into play, depending on whether the participants processed the same metaphors in Chinese (L1) or English (L2). In particular, they found that English metaphors elicited a stronger N400 component than their Chinese counterparts. This difference, according to the authors, might indicate a processing difficulty, which is typically associated with English retrieval of metaphorical meanings. That is, unlike with the L2 metaphors, the participants did not have to reject the literal meaning of the sentence while processing the L1 metaphors (but not the L2 metaphors). In addition to this difference, Chen et al. (2013) showed that compared to the literal sentences, metaphors, particularly those in L2, elicited activation from both hemispheres. With a similar paradigm to Chen et al. (2013), Jankowiak et al. (2017) studied Polish versus English metaphor comprehension with Polish-English bilinguals, presenting conventional and novel metaphors along with literal word dyads as a part of the experiment. They found that there was a decreased sensitivity to the metaphors' conventionality when they were presented in L2. This means that the same metaphors required more mappings of base term on the target term, as they were perceived as less conventional on the Bowdle and Gentner's (2005) continuum when they were presented in L2, even though the participants were proficient in L2. In line with the Career of Metaphor Model, there was no difference between the processing of literal and conventional metaphoric stimuli in terms of ERPs in L1-Polish. Supporting this finding, there was also no ERP differences between L1-metaphors and literal sentences in Chen et al. (2013). This shows that, in participants' first language, conventional metaphors were processed similarly to literal stimuli. Although these studies are informative about how literal statements and metaphors are processed, they did not compare literal spatial statements and spatial metaphors of time. This type of comparison can inform us about how spatial language is processed when it is used to encode spatial and/or temporal relations.

In our study, we recruited L1 Turkish – L2 English speakers. Turkish and English are similar in how they map space onto time in spatial metaphors. These two languages offer a possibly fruitful avenue for the comparison of metaphor processing depending on the language metaphors are processed in, and L2 proficiency in L2 metaphor processing. However, they also differ from each other in two points reported in the literature. First, in Turkish, usually, a synonym of ‘zaman’ (the Turkish equivalent of ‘time’), which is “vakit,” is used when someone talks about a somewhat limited period of time, such as dawn or evening (Ördem, 2014). For example, although both “dawn time” and “time does not have a purpose” use the same word in English, different words for these two stretches of time are used in Turkish as in “şafak *vakti*” and “*zamanın* bir amacı yok.” Second, English has more manner verbs (e.g., crawl, drip and many more that we do not commonly use in Turkish) that denote the movement of time, or temporal events, compared to Turkish (Özçalışkan, 2004). To investigate the developmental trajectories of spatial metaphors of time in English and Turkish, Özçalışkan (2004) studied the ‘TIME IS A MOVING ENTITY’ metaphor with Turkish- and English-speaking monolingual children and adult speakers. The participants had to retell a story that was centered around this metaphor and answer some comprehension questions regarding the metaphor and story (e.g., ‘Does time fly?’, ‘What does it mean when time flies/drips?’). The results showed that Turkish- and English-speaking participants showed the same patterns of comprehension and development in metaphorical processing, along with highlighting the language-based variation in how Turkish- and English-speaking children denoted the metaphorical movement of time. English-speaking children used a greater variety of motion verbs (e.g., crawl, drip and so on) for the movement of time compared to Turkish-speaking children (e.g., fly).

In sum, research has shown that although languages use space to express time, they differ in the way they map space onto time. Moreover, learning a different language can add new mappings to our repertoire. Metaphor comprehension studies have targeted the same metaphors and looked for processing differences. These studies found differences in the processing of the same metaphors when they were presented in L1 versus L2, seemingly related to the difficulty of mapping the base term onto the target term in L2. Less is known about how we process spatial metaphors of time in the bilingual context. To pinpoint the processing differences between the same metaphors arising from language differences, we need more studies that compare languages with similar spatial mappings of time that speakers of them commonly use. This would provide an opportunity to see only the processing differences stemming from the language differences, keeping everything else (e.g., the mappings) constant. According to the Career of Metaphor framework, metaphors are on a continuum that ranges from conventional to novel metaphors. As a metaphor moves toward the conventional end, the processing of it requires fewer mappings between the base and target term (i.e., mapping of space onto time). As shown by Jankowiak et al. (2017), same conventional metaphors are perceived as less conventional when they are processed in L2, meaning that there will be more mappings between base and target terms. Although there have been comparisons of Polish versus English and Mandarin versus English metaphors, there has been no study comparing two languages that have been shown to have same mappings and developmental trajectory of the spatial metaphors of time. This is important because the same mappings and developmental patterns mean that we can investigate the language-based processing differences in the spatial metaphors of time without the possible effects of different mappings and development patterns. The proposed study intended to fill this gap in the literature.

Does studying metaphors only at the verbal level help point out similarities and differences between the mappings in different individuals' minds? Can there be hidden mappings in our minds that we cannot express in language because of its limitations? Murphy (1996) addressed these shortcomings and highlighted the need for alternative evidence to ensure and deeply study the metaphors' psychological reality. This alternative evidence can come from studying gestures.

1.2 Gestures

Gestures are movements of our body that we produce as we speak (McNeill, 1992). These movements that we mostly make with our hands and arms form an integrated system with verbal language and thought (McNeill, 2005). McNeill (1992) proposed four categories of gestures that are related to what we say and think. *Iconic* gestures depict the images of concrete entities like actions and objects such as alternating between the index and middle fingers while saying 'run.' *Deictic* gestures are pointing gestures that are typically made with an extended index finger such as pointing to a car passing by while saying, 'look at the car.' Beat gestures generally take the form of flicks of hands and quick hand movements that keep the beat with the rhythm of speech. Last, *metaphoric* gestures depict the images of abstract ideas. Metaphoric gestures differ from the iconic gestures not with their morphology but with what they refer to. To illustrate, drawing an arc with one's hand while saying, 'time flies' is an example of metaphoric gestures. As evident from this categorization, our gestures relate to what we say and think in different ways. Gestures, however, do more than merely relate to what we say and think. In their gesture-for-conceptualization hypothesis, Kita and colleagues (2017) argue that gestures can activate, manipulate, package, and explore spatial information with evidence from a wide range of tasks, including mental rotation and verbal descriptions of various scenes, events. For this reason, studying gestures in contexts that include space can provide valuable insights into how we use space. As reviewed above, one such context is time. Gestures we use in temporal contexts are called temporal gestures and have sparked some interest in the literature.

Temporal gestures are related to time, and we produce them as we talk about time. These gestures take different forms depending on the temporal relation/concept they depict. Their forms range from a downward stroke of the hand to an arc symbolizing the movement of the temporal events or time itself. One of the first and detailed discussions about these gestures is the one provided by Calbris (1990) about French gestures. These temporal gestures relate to duration, sequence, and other features of temporal events and people locate temporal events or concepts like past, future, and now with reference to their bodies. As a result, one points to the back while talking about past or places a temporal event aligned with one's body if it takes place now. In addition to conforming to the coding of time in language, gestures reveal thinking patterns about time that are not present in language. People use the lateral (left-right) axis when they gesture as they talk about time, an axis that is not employed when they talk about time (Casasanto & Jasmin, 2012). For example, 'Let's put everything to the left of us' is semantically anomalous if one intends to talk about time. The findings of Casasanto and Jasmin (2012) showed that people used the sagittal axis when they were asked to gesture, as they thought about and complied with the linguistic encoding of time. However, when people gestured spontaneously without any prompts, they mostly used the lateral axis that is not present in the language. This finding shows that we sometimes depart from the patterns in language when we think about time, and these ways of thinking are observable through gestures.

Observing different ways of thinking about time has brought about the need for a gesture classification to better analyze how we spatialize time. Cooperrider and Nunez (2009) showed that people use different types of temporal gestures as they express different relations in the domain of time. Thus, an overarching categorization of metaphorical gestures was not sufficient to denote the richness people exhibit while talking and thinking about time. Elaborating on the variety of temporal gestures, they offered a classification scheme for temporal gestures. Their scheme broke down the temporal gestures into five categories. These were *placing* gestures that were used to place temporal events in the gesturer's gestural space, *pointing* gestures that were used to point to the temporal events as if they had real locations, *duration – marking* gestures that were used to show the duration (i.e., metaphorical size) of temporal events, *bridging* gestures that were used to highlight the sequential nature of the temporal events that follow each other, and *animating* gestures that were used to enact the idea that time is an agent/object with its own motion along an axis. This classification showed that we really depict different metaphors of time with our hands. Although Cooperrider and Nunez (2009) first introduced these gestures as 'transversal temporal gestures,' there is no reason that they cannot be used on the sagittal axis as well (K. Cooperrider, personal communication, March 16, 2019). They argued that the spontaneous nature of their paradigm and, crucially, their stimuli's horizontal layout might have primed the participants to use the transversal axis. In another study, Bostan et al. (2016) examined temporal expressions in speech and gesture in Turkish with participants engaging in fortune-telling sessions recorded on video. The results showed that Turkish speakers produced metaphoric and beat gestures more than the other types when they talked about time. Contrary to the earlier findings, the participants in this study produced their majority of the spontaneous temporal gestures on the sagittal axis. The authors explained this finding by the nature of the conversation as the participants talked mostly about the future with the listeners sitting across them. This finding and interpretation show that people can use the sagittal axis in their spontaneous gestures when they are not primed by laterally oriented stimuli, which was the case in Cooperrider and Nuñez (2009). Besides the lateral and sagittal axes, temporal gestures can be produced on the diagonal axis as well. Walker and Cooperrider (2015) showed that we combine lateral and sagittal metaphors of time in online temporal reasoning. As a result, we sometimes produce temporal gestures on the diagonal axis that conform both to the future-in-front and future-to-right mappings by moving our hands forward-rightward. Although it is not as frequent as the lateral and sagittal axes, the diagonal axis is of theoretical value as well.

Previous research mostly examined representational temporal gestures, but according to Casasanto (2008) beat gestures can also represent conceptual processes while thinking about time. As a starting point, Casasanto (2008) found that even meaningless motor actions were related with metaphors. In the study, the participants were asked to move marbles upward or downward while recounting positive or negative memories. The results showed that participants retrieved memories faster when the valence and movement were congruent according to the GOOD is UP metaphor. Similarly, although beat gestures are regarded as non-representative, they were affiliated with the metaphorical content of the participants' narratives in a different study of Casasanto (2008). For example, the participants produced beat gestures with upward strokes when the metaphorical direction of the narrative was up (e.g., 'My grades went up.'). The direction of the strokes was consistent with the accompanying speech's metaphorical direction even when there was no metaphorical use of space in speech. For example, the participants still produced beat gestures with upward strokes when they said, 'My grades got better' instead of using a spatial metaphor. The affiliation of beat gestures with the metaphorical schemas of the narratives was strong, almost all beat gestures had strokes congruent with the schemas of the narratives. These results show that beat gestures might have a representational component when they are used in metaphorical context.

Last, previous research hints at a hand-specificity effect for gesture while explaining metaphors. Kita, de Condappa, and Mohr (2007) showed that there was a decreased right-hand preference while explaining metaphors, but not concrete sentences or abstract concepts which were not metaphors. Supporting this finding, Chen et al. (2013) found that metaphors elicited bilateral activations in the brain, compared to the literal stimuli. In line with the Career of Metaphor Model, the bilateral activation was stronger for the metaphors in L2, as their metaphorical meaning was stronger as a result of their novelty. Argyriou, Mohr, and Kita (2017) further showed that left-hand gestures were not only associated with the metaphoricity of metaphor explanations, but they also played a causal role in increasing the metaphoricity, that is, how well participants described metaphorical mappings between the source and the target domains. These findings show that left-hand involvement in gestures during metaphoric processing should be expected to show itself, and it was logical to expect bimanual gestures when participants explain metaphors but not literal sentences.

To summarize, gestures have been regarded as an access to the cognitive processes as they are not subject to the limitations of language. Temporal gestures, as a sub-category of metaphoric gestures, reflect the mappings of space onto time in our minds that do not necessarily conform with the linguistic expressions. Temporal gestures may as well relate to how we process the spatial metaphors of time as gestures' role in conceptualization shown by Kita et al. (2017). This relation can also extend to the second language metaphor processing. But first, what happens to gestures when another language, hence another system to work in coordination with, is introduced into the mind?

Gestures are part of the gesture-thought-language trio that constitutes a single mental process (McNeill, 2005). Therefore, gesture in the bilingual context presents an interesting analysis on how possible changes in mental processes are reflected in gestures as we switch between languages. For example, bilinguals seem to gesture more than monolinguals, because they may carry over the gesture patterns of one language to the other (Pika, Nicoladis, & Marentette, 2006). In particular, the gestures were transferred from the higher gesture frequency language to the lower gesture frequency language (Pika, Nicoladis, & Marentette, 2006). Moreover, the participants did not suppress the gesture rate of one language while switching to the other language. In another study, Sherman and Nicoladis (2004) found that both English-Spanish and Spanish-English bilinguals used more deictic gestures in their second language, whereas Marcos (1979) did not find such a difference. As for the iconic gestures, although the use of iconic gestures did not differ between languages in these two studies, English - Chinese bilinguals used more iconic gestures in their second language (in another study) (Nicoladis, Pika, Yin, & Marentette, 2007).

There are no consistent findings regarding iconic and deictic gestures in the bilingual context. In other words, language's possible effects on gestures are inconclusive with contradicting results on the concrete gestures. For the metaphoric gestures that relate to time, despite being studied in English and in a few other languages, we know of no experimental study that compared the use of temporal gestures in Turkish and bilinguals. To date, it has been shown that new metaphorical timelines can be introduced to one's mind via second language learning and that same metaphors are processed differently in L1 and L2 outside the temporal context (i.e., spatial metaphors of time). However, processing of the same spatial metaphors of time in L1 and L2 has not been studied in relation to gesture yet. Gestures reveal the mental mappings of space onto time, even when these mappings are not apparent in language. Thus, they show how time is conceptualized in terms of space. Using gestures in a bilingual comparison of spatial metaphors of time may reveal the language-driven differences in the processing of these metaphors.

In line with the language effects, one's L2 proficiency might play a role in L2 metaphor processing. Proficient L2 speakers are more practiced in L2, which encompasses the continuous use of common spatial words in their metaphorical meaning. We expected that using spatial language more would render the spatial metaphors of time in L2 more conventional for more proficient L2 speakers, compared to their less proficient counterparts. This elevated conventionality may have required fewer online mappings of space onto time, which may have resulted in less frequent gesturing to activate, manipulate, explore, and package spatial information for both thinking (Kita et al., 2017) and communication purposes in L2. There appears to be a gap in the literature regarding these types of gestures, and this study intends to fill the gap by studying temporal gestures in a bilingual sample.

In this study we examined spontaneous co-speech gestures of university students as they elaborated on literal and metaphorical sentences, which contained the same spatial words in the spatial and temporal sense, respectively. Based on the findings in literature, we hypothesized that participants would produce more gestures while explaining metaphorical sentences in English, compared to Turkish. Alternatively, based on the Career of Metaphor Model (Bowdle & Gentner, 2005) we expected that participants would produce more gestures while explaining literal sentences compared to metaphorical sentences in Turkish. As metaphorical sentences were conventional, their base terms would refer to a somewhat more abstract version of the original base term such as ‘anything that provides a plan’ instead of ‘a blueprint.’ Literal spatial sentences, on the other hand, would still refer to concrete spatial objects, which makes them more spatial than the conventionalized metaphors. Therefore, they would elicit more gestures from the participants. This follows from the findings of Jankowiak et al. (2017), which showed that conventional metaphors were processed similarly to literal meanings in L1 but not in L2. Following from that, we expected our participants to produce more temporal gestures while explaining metaphors in English compared to Turkish, as the English metaphors would be less conventional than the Turkish metaphors. We also expected that the participants would produce more bimanual gestures while explaining metaphorical sentences as metaphor explanation has been shown to involve bilateral activation, and left-hand use in gestures. (Chen et al., 2013; Kita et al., 2007). Last, we expected that our participants would produce more temporal gestures on the lateral axis, compared to the sagittal axis; as we would not give them any instructions on gesture, our participants would read sentences in a left-to-right direction, and most of the past research showed the lateral axis to be dominant (Cooperrider & Nunez, 2009; Casasanto & Jasmin, 2012). To test these hypotheses, we first conducted a pilot study.

1.3 The Pilot Study

To our knowledge, metaphoric/temporal gestures had not been studied in an experimental context in Turkish and in bilinguals yet. Turkish shares almost all its mappings of space onto time with English (Ördem, 2014), and Turkish and English monolingual children show similar trajectories of development in understanding the same spatial metaphors of time (Özçalışkan, 2014). To gain more insight into how Turkish – English bilinguals process spatial metaphors of time, and gesture while talking about time, we first conducted an exploratory study. We used a spontaneous gesture paradigm. Participants had to explain metaphorical and literal sentences in which spatial words were used in their temporal and spatial senses, respectively.

To create a stimulus set, we constructed 20 sentences in English and Turkish. In 10 of them, a spatial word was used in its spatial/literal sense (e.g., He looked toward the *distant* hills/*Uzak* tepelere doğru baktı.), and in the other 10 sentences, the same spatial word was used in its temporal/metaphorical sense (e.g., The movie takes place in the *distant* future/Film *uzak* gelecekte geçiyor.). After that, we pilot tested the metaphorical sentences with 10 participants to see whether these sentences would elicit descriptions and gestures related to time. We asked the participants to explain what each sentence meant and videotaped the sessions. People participated both in Turkish and English sessions in 3- to 4-day intervals. Descriptive analyses revealed that at least 60% of the participants uttered temporal descriptions for all the sentences. Therefore, we did not eliminate any sentences based on this criterion. However, gestures did not follow the same pattern. Three of the sentences did not elicit gestures from at least 50% of the participants in both languages. We used these sentences as warm-up trials in the upcoming pilot study and had the rest of the sentences as experimental stimuli.

We used the same procedure in the stimuli creation in our experimental procedure. Five graduate students (1 male) participated in the study and were asked to explain what each sentence meant to the experimenter while being videotaped. The results showed that the participants produced 605 gestures in total (296 in Turkish sessions), and the number of gestures did not differ between the language conditions. However, the participants gestured significantly more (54%) while explaining metaphorical sentences than while explaining literal sentences (46%) in English. In Turkish, the pattern was the reverse with gestures produced while explaining literal sentences constituting 54% of the total. Since the total number of gestures did not differ in Turkish versus English condition, we compared the temporal gesture percentages in both languages. The results showed that participants made more temporal gestures in the English condition (54%) than in the Turkish condition (46%).

As for hand use, the participants produced more bimanual gestures while describing metaphorical sentences (32%) than while describing literal sentences (13%) in both languages. Moreover, consistent with the findings of Chen et al. (2013), the difference was more pronounced in English, compared to the Turkish condition. Last, contrary to our last hypothesis, but similar to the findings of Bostan et al. (2016) the participants used the sagittal axis more often (59%) than the lateral axis (30%) in their temporal gestures. A close look into our stimuli revealed that majority of our sentences had a deictic temporal reference, which was associated with congruent sagittal, but not lateral gesture production (Casasanto & Jasmin, 2012).

The stimuli creation phase and the pilot study showed that metaphorical sentences about time were very likely to elicit gestures when either time or the observer can be conceptualized as a moving entity or at least as having a location. The results of the study were consistent with the related findings in the literature in two ways. First, when we consider Jankowiak et al.’s (2017) findings, the Career of Metaphor Model (2005), and the Gesture-for-Conceptualization hypothesis (2017) together, the findings showed that there might have been a conventionality difference stemming from the language of processing. This follows from the Career of Metaphor Model showing less conventional metaphors would require more mappings, which was evident from the number of gestures. As Kita et al. (2017) showed, it is very likely that these gestures were used for conceptualization purposes to carry out and express the mappings required by less conventional L2 metaphors. Second, our participants produced more bimanual gestures while describing metaphors in both languages, which is in line with Chen et al.'s findings (2013). The bilateral activation elicited by the metaphors may have been reflected as bimanual gestures. Along with the gaps in the literature, these findings highlighted the need for a more controlled and detailed experiment.

1.4 The Current Study

Given our small sample size and limited number of trials, our results were not conclusive. In addition, the fact that our participants used the sagittal axis more frequently than the lateral axis revealed the need for a more controlled stimulus set in terms of the sentences' implied axes (i.e., equal numbers of sentences that imply lateral and sagittal axes). To find out whether the spatial metaphors of time had been processed differently depending on processing language and L2 proficiency, and whether we could see any possible processing differences through co-speech gestures, we need a more controlled study with a larger sample.

First, we expected our participants to produce more gestures while explaining the metaphorical sentences in English compared to Turkish. As Jankowiak et al. (2017) showed, people were less sensitive to metaphors' conventionality in their L2 but not in L1, such that literal and conventional metaphorical stimuli in L1 elicited similar ERP patterns. This meant that the participants would have to do more online mappings to process (e.g., to comprehend) the metaphors in L2 according to the Career of Metaphor Model (Bowdle & Gentner, 2005). This escalated number of mappings of space onto time would result in higher numbers of gesture in the English sessions as gestures would be used to activate, explore, package, and manipulate spatial information as people process it (Kita et al., 2017). Additionally, in L1, we expected our participants to produce more gestures while explaining literal spatial sentences as those sentences would be as conventional as L1 metaphors (Bowdle & Gentner, 2005) but more concrete in spatial terms. According to Alibali (2005), we gesture more when we talk about spatial content compared to abstract content. We process conventional metaphors in L1 by accessing a more abstract second sense of the concrete base term. Thus, L1 conventional metaphors will be less spatial than L1 literal spatial sentences. Moreover, as they are the primary types of gestures to depict concrete objects and actions (McNeill, 1992), and temporal concepts (Cooperrider & Nuñez, 2009), we expected the hypothesized differences of total gestures to be driven by iconic gestures for literal sentences and temporal gestures for metaphorical sentences. Simply put, we expected to see more temporal gestures in the explanations of L2 metaphors compared to L1 metaphors. Second, we expected that proficient English speakers would overall produce fewer temporal gestures compared to less proficient ones while explaining the metaphors, as the conventionality difference stemming from language would affect them to a lesser extent. Third, we expected that our participants would produce more bimanual gestures while describing metaphorical sentences in general as left-hand gestures have been involved in gestures accompanying metaphor explanations (Argyriou et al., 2017). Moreover, we expected this difference to be more profound in L2, based on Chen et al. (2013). Fourth, we hypothesized that our participants would use the lateral axis more often than the sagittal axis while producing temporal gestures. Based on the findings of the pilot study, we decided to level the numbers of the sentences that imply sagittal and lateral axes. Thus, free from the stimuli effect, our participants should have gestured consistently with the findings in the literature, using the lateral axis more often. Last, we expected that our participants' beat gestures would be affiliated with their metaphorical explanations such that the direction of the gestures would be consistent with the metaphorical direction of the metaphors they are asked to explain, as shown by Casasanto (2008).

Chapter 2:

METHOD

2.1 Participants

Twenty-seven right-handed Turkish-English bilingual undergraduate students (Mage=20.5, 17 females) with normal vision and no history of neurological disorders participated in the study. We determined the sample size by considering similar studies in the literature. Most of the studies had sample sizes ranging from 20 to 35. However, since Cooperrider and Nunez (2009) tested 50 participants to standardize a classification scheme and they conducted one of the most detailed studies of temporal gestures, we decided that 50 would be a proper sample size for the study. Although we could not reach the desired sample size due to the COVID-19 pandemic outbreak, we had enough data for a mixed-effect model. Therefore, we opted to go for mixed-effect models with the data we were able to collect before COVID-19 related lockdown. All participants were native Turkish speakers. We recruited the participants via the subject pool of Koç University for two sessions (for L1 and L2) with a week interval in between. The participants received a course credit in exchange for their participation.

2.2 Task and Stimuli

The participants were shown 24 sentences with a booklet and asked to explain what each sentence meant without any further instructions about gestures. Twelve of these sentences were literal sentences in which the spatial words were used in their spatial sense, and the rest were metaphorical sentences that included these spatial words in their metaphorical/temporal sense (see Table 1 for some sample sentences in different conditions). We selected these sentences from a sentence pool we had created by constructing additional sentences like the ones that elicited gestures in the pilot study (i.e., the sentences in which temporal events or observers are either moving or at least had a location). In the pool, the sentences were equal in terms of their perspective (time-moving or ego-moving) and their implied axes (sagittal vs. lateral). After creating the pool, we picked six sets of 24 sentences from it. Three of the sets (along with their literal counterparts) consisted of ego-moving temporal sentences, whereas the other three consisted of time-moving sentences, both matched for their implied axes. Last, since changes in times of temporal events are also referred to with spatial metaphors in Turkish and English, we included some temporal event manipulation sentences in our sentences pool, which were equally distributed across the sets (e.g., they moved the meeting *forward.)* (see Appendices A and B for the list of sentences).

Table 1. Sample sentences from different languages and types.

Turkish		English	
Literal	Metaphorical	Literal	Metaphorical
Uzak tepelere doğru baktı.	Film ***Uzak*** gelecekte geçiyor.	He looked toward the ***distant*** hills.	The movie takes place in the ***distant*** future.

2.3 Procedure

In the Turkish sessions, after consenting to take part in the study, we asked the participants to perform the sentence description task outlined above. We recorded the sentence description task on the video for later coding analyses. After that, we gave a demographic form and the Turkish version of the Language Experience and Proficiency Questionnaire (LEAP-Q, Marian, Bluemenfeld, and Kaushanskaya, 2007). In the English sessions, we administered Peabody Picture Vocabulary Test-4 (PPVT-4, Dunn and Dunn, 2007) to assess their L2 proficiency after the sentence description task. The order of Turkish and English sessions was counterbalanced. At the end of each session, we asked our participants to rate the clarity of the sentences they had explained on a scale of 1-not clear to 5-very clear.

2.4 Coding

We coded the participants' gestures via ELAN software (Lausberg & Sloetjes, 2009). For the coding, we transcribed the participants' speech first. Then, we coded all gestures based on McNeill's (1992) gesture classification scheme as iconic (e.g., alternating between two fingers to show 'walking'), deictic (e.g., pointing to an object with an extended index finger), beat (e.g., moving one's hand up and down with the rhythm of the speech), and metaphoric (e.g., drawing an arc with one's hand to symbolize the passing of time). We also coded all gestures for hand use as left, right, or both. We coded the temporal gestures for their axis as sagittal (the front back axis), lateral (the left-right axis), or diagonal (a combination of the sagittal and lateral axes, such as a gesture that moves rightward-forward). Additionally, as they were shown to be affiliated with the metaphorical direction of the narrative (Casasanto, 2008), we coded the beat gestures for the congruency of their direction with the participants' descriptions (see Appendix C for the detailed coding scheme).

2.5 Reliability

The first author and another research assistant coded 20% of the data independently for reliability analysis. The two raters agreed 90.52% on detecting the gestures and 77.96% on assigning types to the gestures. The disagreements were settled through discussion.

Chapter 3:

RESULTS

Five participants were excluded from the data because they could not participate in the second session due to the COVID-19 pandemic. The data of three more participants was discarded because two of them did not provide proper explanations for the sentences and one participant's session was not successfully completed due to an experimenter error. Our final data consisted of 19 participants and 48 trials for each participant. We had to exclude 4 trials due to a technical error in obtaining conventionality ratings. Thus, our final data included 908 trials from 19 participants. We conducted our analyses on these trials.

We used multi-level mixed effects models (Bates et al., 2015) on R (R Core Team, 2013) to test our hypotheses about gesture use (i.e., the total number of co-speech gestures, and the use of bimanual gestures). We included the random intercepts of subjects and items as random effects in all models. We scaled our continuous predictor variables to avoid convergence problems in models and to facilitate interpretation (Bates et al., 2015). For the comparisons including categorical predictors, we used the *emmeans* and *contrast* functions of the *emmeans* package in R (Lenth, 2020). We tested and plotted the interactions which involved a continuous predictor with the *probe_interaction* function of the *interactions* package (Long, 2019) and visualized them using the *interact_plot* function of the *ggplot2* (Wickham, 2016) package. We conducted Friedman's Two-Way Analysis of Variance for the lateral axis hypothesis and Wilcoxon Signed Rank Test for the beat gesture congruency hypothesis as they required comparisons of different types of gestures for the corresponding conditions rather than a gesture type's association with conditions and/or conventionality ratings.

3.1 Preliminary Analyses

We obtained conventionality ratings from the participants for each sentence. To decide whether to include the conventionality ratings in further analyses, we asked whether these ratings were associated with the type (i.e., metaphorical/literal) or language (i.e., Turkish/English) of the sentences and the participants' PPVT-4 scores (*M*=166.68, SD=21.09). Table 2 shows the descriptive statistics for the conventionality ratings of the sentences across different conditions.

Table 2. Descriptive statistics for the conventionality ratings of the sentences across different conditions.

Language	Type	*N*	*Mean*	*SD*
Turkish	Metaphorical	228	3.96	1.01
Turkish	Literal	228	3.88	1.11
English	Metaphorical	228	3.69	1.17
English	Literal	228	3.93	1.05

In Model 1, the outcome variable was the conventionality ratings of the sentences and the fixed factors were the type and language of sentences, PPVT scores, and all the interactions between these factors. The model statistics for conventionality ratings can be found in Table 3.

Table 3. Model summary for the conventionality ratings (Model 1).

	Conventionality Ratings (Model 1)	
	Coefficient	**SE**
FIXED EFFECTS		
Intercept (=Turkish / Metaphorical)	3.94***	.13
Sentence Type	-.01	.13
Language (English)	-.24†	.12
PPVT	.28*	.12
Sentence Type x Language	.28	.18
Sentence Type x PPVT	-.27**	.09
Language x PPVT	.04	.09
Sentence Type x Language x PPVT	.20†	.12
	Variance	**SD**
RANDOM EFFECTS		
Subject Intercept	.19	.44
Sentence Intercept	.11	.33

Note: SE=Standard Error, Significance codes= ***p < .001, **p < .01, *p < .05, †p<.1

For conventionality ratings, one-point increase in PPVT scores was associated with .28 ± .12 points increase in conventionality ratings, t=2.36, p=.03. This association was modulated by the type of the sentence we asked participants to explain (Figure 1). One-point increase in PPVT scores was associated with .26 ± .11 points higher conventionality ratings only for metaphorical sentences, t=2.36, p=.03.

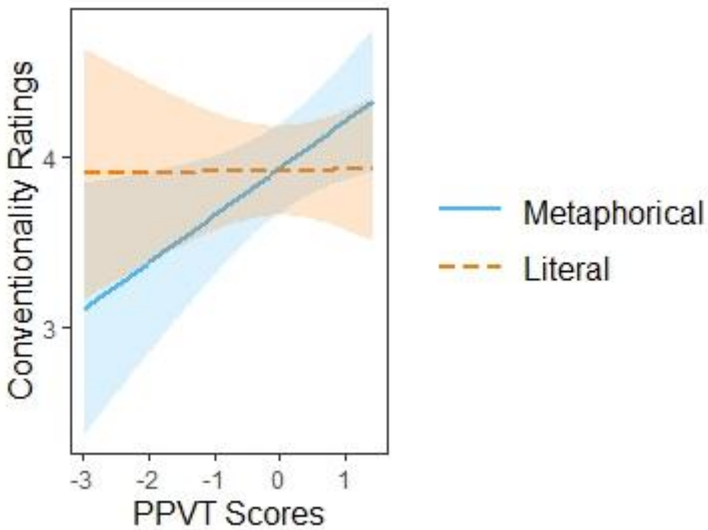

Figure 1. The interaction between sentence type and PPVT scores. The hues around the lines show 95% confidence intervals.

Having found some associations of sentence type, language, and PPVT scores with how conventional the sentences were for our participants, we included conventionality ratings as a predictor in our further gesture models.

3.2 Comparisons of Gesture Use in L1 and L2

3.2.1 Total Gestures

The participants produced a total of 2798 gestures in 908 trials. The descriptive statistics of gestures (total and per each type) based on language and type of sentences can be found in Table 4.

Table 4. Descriptive statistics of gestures produced per sentence across different languages and types.

Language	Type	*N*	Total Mean (SD)	Temporal Mean (SD)	Iconic Mean (SD)	Pointing Mean (SD	Beat Mean (SD)
Turkish	Metaphorical	228	2.62 (2.96)	1.31 (1.70)	.10 (.34)	.05 (.3)	1.17 (1.92)
Turkish	Literal	228	3.46 (3.69)	.44 (.32)	1.91 (2.14)	.13 (.47)	1.38 (2.44)
English	Metaphorical	228	3.47 (3.44)	1.86 (2.24)	.04 (.18)	.22 (.15)	1.56 (2.18)
English	Literal	228	2.71 (2.64)	.7 (.32)	1.39 (1.59)	.16 (.44)	1.09 (1.72)

We used multi-level mixed effects models (Bates, Mächler, Bolker, & Walker, 2014) on R (R Core Team, 2013) to test our hypotheses about gesture frequency across different conditions. We fitted 4 different models with total gestures (Model 2), temporal gestures (Model 3), iconic gestures (Model 4), and beat gestures (Model 5) as outcome variables. Our fixed factors in these models were sentence type, sentence language, PPVT-4 scores, and the conventionality ratings of the sentences, along with all interactions between these four. Table 5 shows the summaries for these models.

Table 5. Model summaries for total (Model 2), temporal (Model 3), iconic (Model 4), and beat gestures (Model 5).

	Total Gestures (Model 2)		Temporal Gestures (Model 3)		Iconic Gestures (Model 4)		Beat Gestures (Model 5)	
	Coefficient	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**
FIXED EFFECTS								
Intercept (=Turkish / Metaphorical)	2.64***	.5	1.36***	.15	.05	.15	1.19***	.32
Sentence Type (Literal)	0.81**	.25	-1.32***	.15	1.82***	.14	.19	.16
Language (English)	0.83**	.26	.56***	.15	-.06	.14	.36*	.16
CR	-.21	.19	-.02	.10	.08	.15	-.05	.13
PPVT	-.24	.49	-.30*	.14	-.09	.10	-.03	.32
Sentence Type x Language	-1.57***	.36	-.53*	.21	-.45*	.19	-.06**	.22
Sentence Type x CR	.23	.24	-.03	.13	-.31**	.12	-.01	.16
Language x CR	.36	.24	.18	.13	.01	.12	.08	.16
Sentence Type x PPVT	-.08	.23	.27*	.12	.22†	.12	-.02	.16
Language x PPVT	-.61*	.24	-.28*	.13	.06	.12	-.03*	.16
CR x PPVT	.07	.17	-.25**	.09	.21*	.09	-.08	.12
Sentence Type x Language x CR	-.39	.33	-.15	.18	-.14	.17	-.06	.22
Sentence Type x Language x PPVT	.47	.33	.31†	.17	-.15	.17	.2	.22
Sentence Type x CR x PPVT	-.36	.24	.34**	.13	-.65***	.12	.01	.16
Language x CR x PPVT	-.07	.23	-.15	.12	.01	.12	.07	.15
Sentence Type x Language x CR x PPVT	.46	.35	.12	.18	.43	.18	-.07	.24
	Variance	**SD**	**Variance**	**SD**	**Variance**	**SD**	**Variance**	**SD**
RANDOM EFFECTS								
Subject Intercept	4.03	2.01	.32	.57	.27	.52	.01	.08
Sentence Intercept	0.16	.4	.13	.36	.08	.28	1.66	1.29

Note: SE=Standard Error, CR=Conventionality Rating, Significance codes= ***p < .001, **p < .01, *p < .05, †p<.1

For total gestures, we found main effects of both sentence type and language. On average, literal sentences were associated with .81 ± .25 more gestures than metaphorical sentences, t= 3.19, p=.002. In addition, English sentences were associated with .83 ± .26 more gestures than Turkish sentences, t=3.21, p=.002. These two effects interacted with each other (Figure 2). In Turkish sessions, our participants produced .81 ± .26 more gestures while explaining literal sentences compared to metaphorical sentences, t=-3.12, p=.002. In English, on the other hand, they produced .76 ± .26 more gestures while explaining metaphorical sentences compared to literal sentences, t=2.92, p=.004.

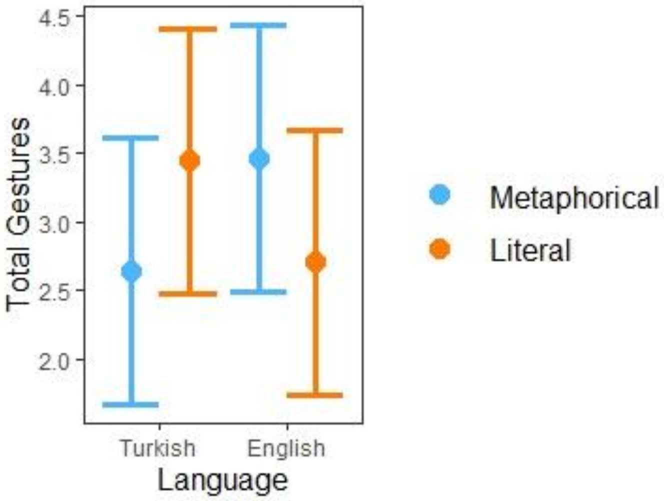

Figure 2. The interaction of sentence type and language. The brackets show 95% confidence intervals.

We also found an interaction of language and PPVT scores (see Figure 3). One-point increase in PPVT scores was associated with .29 ± .13 fewer gestures only in English sentences t=-.2.27, p=.03.

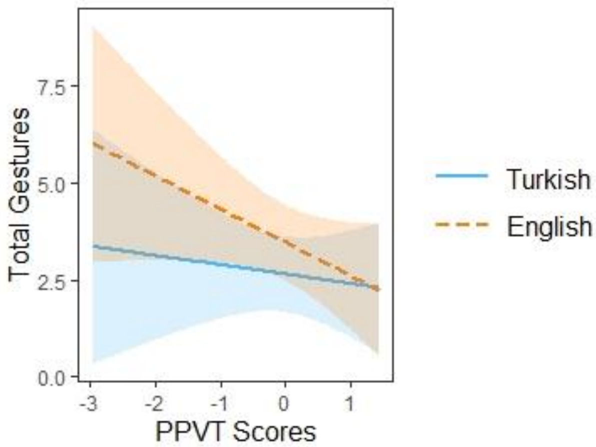

Figure 3. The interaction of PPVT scores with sentence language. The hues around the lines show the 95% confidence intervals.

In sum, we found that our participants produced more gestures while explaining literal sentences in Turkish and metaphorical sentences in English. Moreover, the participants with higher PPVT scores (i.e., more proficient L2 speakers) produced fewer gestures while explaining sentences in English.

3.2.2 Temporal Gestures

For temporal gestures, we again found main effects of item type and language (see Table 5). Metaphorical sentences were associated with 1.32 ± .15 more temporal gestures compared to metaphorical sentences, t= 8.77, p<.001. English sentences were associated with .56 ± .15 more temporal gestures than Turkish sentences, t= 3.67, p<.001. There was a main effect of the PPPT scores as well. One-point increase in PPVT scores was associated with .3 ± .1 fewer temporal gestures on average t=-2.14, p=.03. There was also an interaction between sentence type and language, t=8.58, p<.001; t=12.01, p<.001 (Figure 4). Our participants produced .55 ± .16 more temporal gestures for English metaphors than Turkish metaphors, t= -3.59, p<.001.[1]

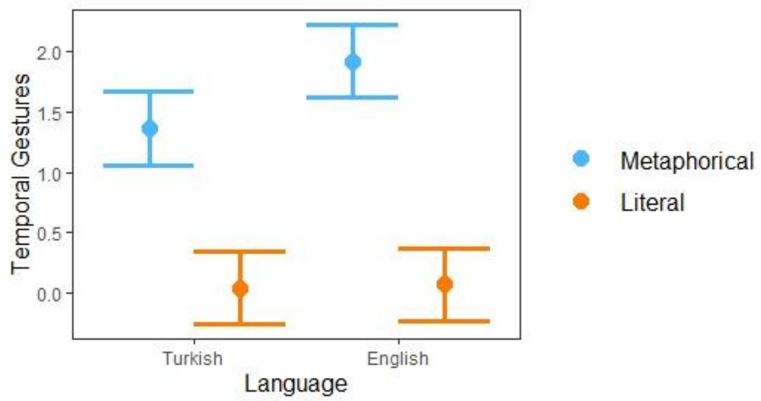

Figure 4. The interaction of sentence type and language. The brackets show 95% confidence intervals.

There was also an interaction of sentence type and PPVT scores. One-point increase in PPVT scores was associated with .44 ± .13 fewer temporal gestures only for metaphorical sentences, t=-3.5, $p<.001$. In addition to sentence type, we found an interaction of sentence language with PPVT scores. One-point increase in PPVT scores was associated with .29 ± .13 fewer temporal gestures only in English sentences, t= -2.27, p=.03.

The PPVT ratings also interacted with the conventionality ratings of the sentences to predict the number of temporal gestures our participants produced. One-point increase in PPVT scores was associated with .35 ± .13 fewer temporal gestures for sentences with conventionality ratings 1 SD above the mean, t=-2.68, p=.01. There was no interaction for the sentences with conventionality levels at and below the mean level.

As shown in Figure 5, we found a marginally significant three-way interaction between sentence type, language, and PPVT scores. One-point increase in PPVT scores was associated with .3 ± .1 and .58 ± .1 fewer temporal gestures only for metaphorical sentences in both Turkish and English, respectively (t=-2.14, p=.04; t=-4.03, p<.001).

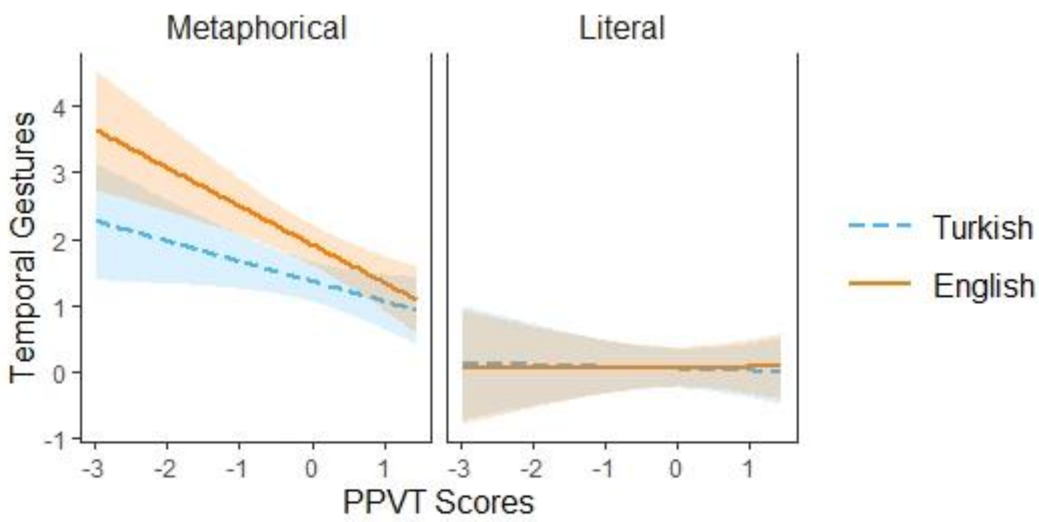

Figure 5. The interaction of sentence type, language, and PPVT scores. The hues around the lines show the 95% confidence intervals.

Last, we found a three-way interaction between sentence type, conventionality ratings, and PPVT scores (Figure 6). One-point increase in PPVT scores was associated with .44 ± .13 and .77 ± .15 fewer temporal gestures for metaphorical sentences with conventionality ratings at the mean level and 1 SD above the mean, respectively (*t*=-3.45, *p*<.001, *t*=-4.95, *p*<.001). The interaction was not significant for the metaphorical sentences 1 SD below the mean conventionality.

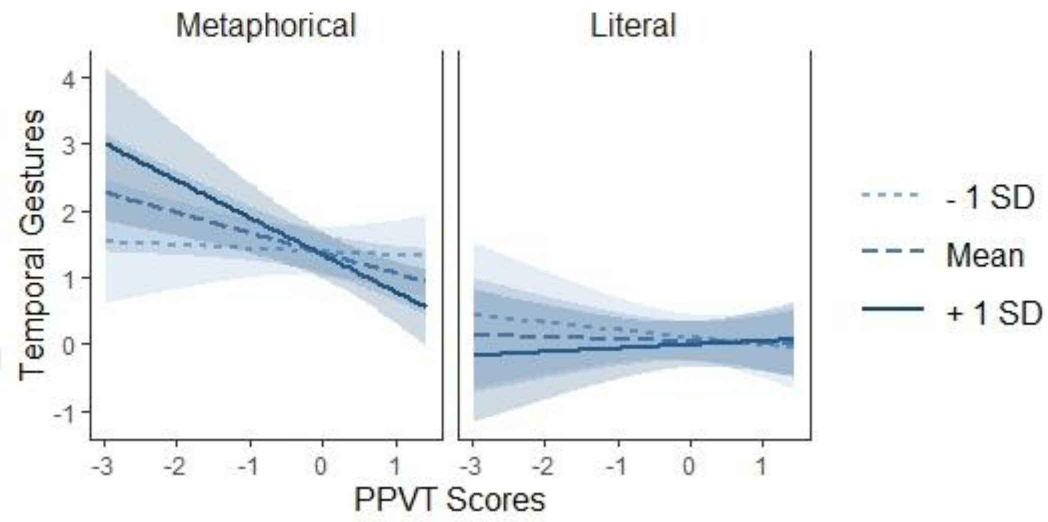

Figure 6. The interaction of sentence type, conventionality ratings and PPVT scores. The hues around the lines show the 95% confidence intervals.

In sum, our participants produced more temporal gestures while explaining metaphors in English, compared to Turkish. We found that those with higher PPVT scores produced fewer temporal gestures. This association was apparent for the sentences with mean and above conventionality ratings.

3.2.3 Iconic Gestures

Our participants' iconic gesture use was associated with sentence types as well. On average, they produced 1.82 ± .14 more iconic gestures while explaining literal sentences, *t*= 13.27, *p*<.001. We did not find main effects of language, PPVT scores, and conventionality ratings for iconic gestures. The main effect of sentence type was modulated by language, *t*=-13.32, *p*<001; *t*=-9.96, *p*<.001 (see Figure 7). Our participants produced .51 ± .13 more iconic gestures for Turkish literal sentences compared to English sentences, t=3.78, p<.001.[2]

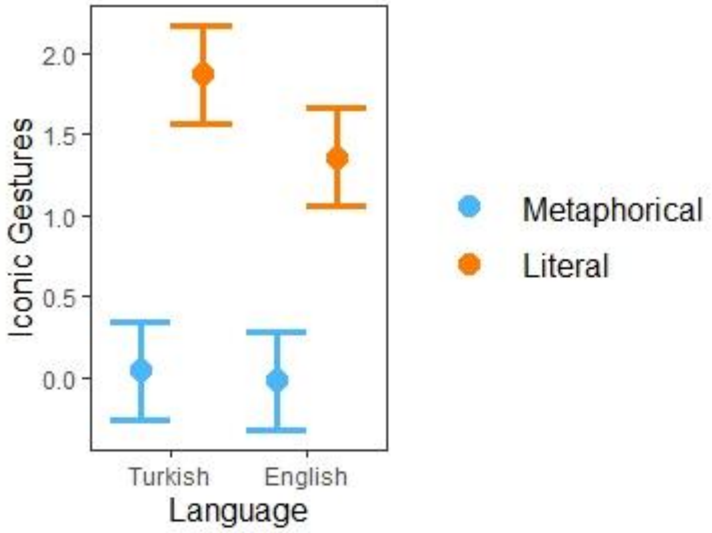

Figure 7. The interaction of sentence type and language. The brackets show 95% confidence intervals.

We also found an interaction between sentence type and conventionality ratings However, none of the sentence types significantly interacted with conventionality ratings on their own. The interaction of sentence type with PPVT scores was significant as well. One-point increase in PPVT scores was associated with .29 ± .13 fewer iconic gestures while explaining literal sentences, t= -2.18, p=.04. In addition, we found an interaction of PPVT scores with conventionality ratings. However, none of the conventionality levels significantly interacted with PPVT scores on their own.

Last, there was a three-way interaction of sentence type, PPVT scores and conventionality ratings (see Figure 8). One-point increase in PPVT scores was associated with .29 ± 13 and .5 ± .15 fewer iconic gestures for literal sentences with conventionality ratings at the mean level and 1 SD above it, respectively (t= -2.18, p=.04; t=-3.44; p<.001).

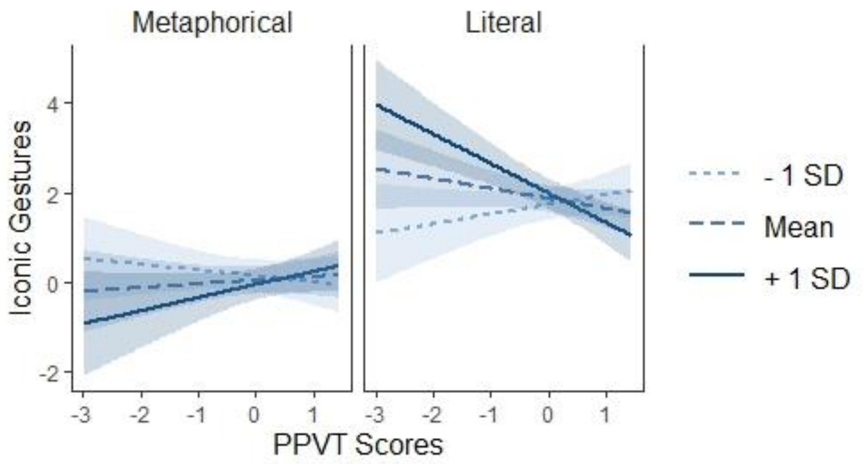

Figure 8. The interaction of sentence type, PPVT scores, and conventionality ratings. The hues around the lines show the 95% confidence intervals.

In sum, the participants produced more iconic gestures while explaining Turkish literal sentences than English ones as well. Similar to temporal gestures, the participants with higher PPVT scores produced fewer iconic gestures while explaining sentences with mean and above conventionality ratings.

3.2.4 Beat Gestures

For beat gestures, we found a main effect of language. English sentences were associated with .36 ± .16 more beat gestures compared to Turkish sentences, t=2.28, p=.02. We also found an interaction of sentence type and language (see Figure 9). There was no difference between literal and metaphorical sentences in Turkish. In English, metaphorical sentences were associated with .45 ± .16 more beat gestures than literal sentences, t=2.81, p=.01. Moreover, English metaphorical sentences were associated with .36 ± .16 more beat gestures than Turkish metaphorical sentences, t=-2.23, p=.03.

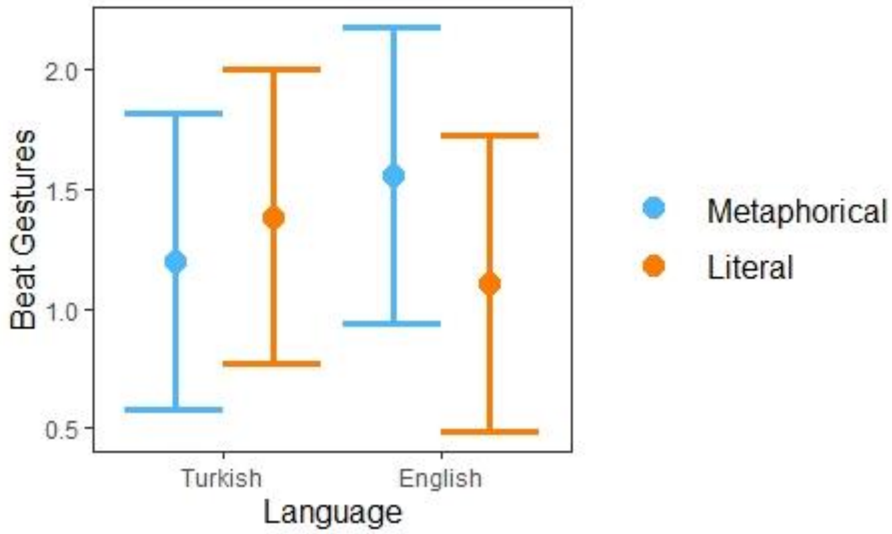

Figure 9. The interaction of sentence type and language. The brackets show the 95% confidence intervals.

There was also a significant interaction of PPVT scores and sentence language but neither language interacted significantly with PPVT scores to predict the number of gestures on their own.

3.3 Bimanual Gestures

The distribution of bimanual gestures by language and sentence type can be found in Table 6. We asked whether bimanual gestures were associated with the fixed factors we used to analyze total, iconic, temporal, and beat gestures (Model 6). Different from the previous models, the total number of bimanual gestures was the outcome variable in this model. The summary for Model 6 can be found in Table 7.

Table 6. The distribution of bimanual gestures by sentence language and type.

Language	Type	*N*	*Mean*	*SD*
Turkish	Metaphorical	228	1.17	1.86
Turkish	Literal	228	1.55	2.03
English	Metaphorical	228	1.30	1.96
English	Literal	228	0.91	1.39

Table 7. Model summary for bimanual gestures (Model 6).

	Bimanual Gestures (Model 6)	
	Coefficient	**SE**
FIXED EFFECTS		
Intercept (=Turkish / Metaphorical)	1.19***	.26
Sentence Type (Literal)	0.34*	.16
Language (English)	0.10	.16
CR	-.16	.26
PPVT	-.12	.11
Sentence Type x Language	-.74**	.23
Sentence Type x CR	-.04	.14
Language x CR	-.17	.15
Sentence Type x PPVT	.05	.15
Language x PPVT	.11	.15
CR x PPVT	-.07	.11
Sentence Type x Language x CR	.10	.2
Sentence Type x Language x PPVT	.2	.2
Sentence Type x CR x PPVT	-.04	.15
Language x CR x PPVT	.01	.14
Sentence Type x Language x CR x PPVT	.1	.21
	Variance	**SD**
RANDOM EFFECTS		
Subject Intercept	1.07	1.04
Sentence Intercept	.08	.29

Note: SE=Standard Error, CR=Conventionality Ratings, PPVT= PPVT Scores, Significance codes= ***p < .001, **p < .01, *p < .05, †p<.1

We found a main effect of sentence type. Literal sentences were associated with .34 ± .16 more bimanual gestures compared to metaphorical sentences, *t*= 2.13, *p*= .04. There was no main effect of language. However, as seen in Figure 10, language modulated the association of sentence type with bimanual gesture production. Our participants produced .34 ± .16 more bimanual gestures while explaining literal sentences compared to metaphorical sentences in Turkish, *t*= -2.09, *p*=.04. In English, on the other hand, they produced .40 ± .16 more bimanual gestures while explaining metaphorical sentences compared to literal sentences, *t*= 2.47, *p*=.02.

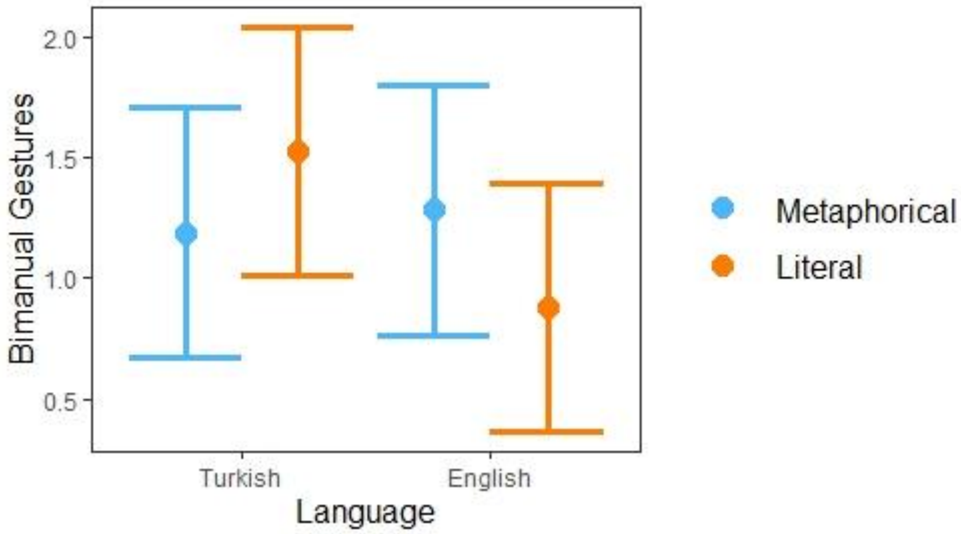

Figure 10. The interaction of sentence language and type. The brackets show 95% confidence intervals.

3.4 Gesture Axes

We tested our gesture axes hypothesis using Friedman's Two-Way Analysis of Variance. The results showed a difference in the frequency our participants used the lateral, sagittal and the diagonal axes in Turkish sessions, $\chi 2(2, N=19) = 13.48$, $p=.001$. Dunn-Bonferroni post-hoc tests showed that the participants used both lateral (M=2.32) and sagittal (M=2.26) gestures more frequently than diagonal gestures (M= 1.42), p=.02 and p=.*03*, respectively. There was no difference between the use of lateral and sagittal gestures, $t(18)=.16$, $p=.87$.

There was a difference in the use of the three axes in English sessions as well, $\chi 2(2, N= 19) = 18$, $p<.001$. The participants, again, produced more gestures on the lateral (M=2.55) and sagittal (M=2.16) axes than the diagonal axis (M=1.29), $p<.001$ and p=.*02*, respectively. The use of the lateral versus sagittal axis was not different, $t(18)=1.22$, $p=.67$.

Table 8. Average number (sd) of temporal gestures produced on the lateral, sagittal, and diagonal axes by language.

Gesture Type	Turkish	English
Lateral	5.42 (5.74)	9.05 (8.23)
Sagittal	3.84 (3.88)	5.05 (5.02)
Diagonal	1.21(1.36)	1.79 (3.44)

We used Wilcoxon Signed Rank Test to test our hypothesis about beat gestures. If a beat gesture was congruent with the metaphorical mapping of the speech (e.g., a forward stroke for the joyful vacation "ahead of" oneself) coded as congruent. If a beat gesture did not follow the metaphorical mapping in speech, we coded it as incongruent. Table 9 shows the numbers of total, congruent, and incongruent beat gestures produced while explaining metaphorical sentences. Some beat gestures did not have a clear, codable direction and were left out of the congruency coding.

Table 9. The numbers of total, congruent and incongruent beat gestures.

Language	Type	*N*	Total	Congruent	Incongruent
Turkish	Metaphorical	228	266	183	37
English	Metaphorical	228	356	203	73

Our participants produced more congruent (M=9.7, SD=14.2) than incongruent beat gestures (M=1.9, SD=3.7) in Turkish, Z=-3.35, p=.001. The participant produced more congruent (M=10.7, SD=10.3) than incongruent beat gestures (M=4.1, SD=3.9) in English as well, Z=-3.73, p<.001.

Chapter 4:

DISCUSSION

This study investigated the differences between L1 and L2 temporal gestures regarding their connection to metaphor comprehension. We asked whether metaphors were processed differently in L1 and L2, and from literal/spatial sentences in each language, and whether these differences were reflected in co-speech gestures. We expected our participants to produce more gestures in total while explaining metaphorical sentences in English and literal sentences in Turkish, as English metaphors would be less conventional than English literal sentences and Turkish literal sentences would be more spatial than their equally conventional metaphorical counterparts. As for specific types of gestures, we hypothesized that the participants would produce more temporal gestures while explaining metaphors in English, compared to Turkish. We also hypothesized that temporal gesture production would be associated with individuals' L2 proficiency, such that higher L2 proficiency scores would be associated with fewer temporal gestures. For the hand use, we expected to see more bimanual gestures for metaphorical sentences in each language, and the difference between literal and metaphorical sentences would be larger in English. Last, we hypothesized that our participants would produce temporal gestures more frequently on the lateral axis than the sagittal axis and their beat gestures' direction would be congruent with the directions of the metaphors they explained.

We found that people produced more gestures in total while explaining literal sentences in Turkish and metaphorical sentences in English. The data also supported our hypotheses about temporal gestures produced while explaining L2 metaphors. Moreover, we found that higher PPVT scores were associated with fewer temporal and iconic gestures. Our hand use hypothesis was partially supported with more bimanual gestures for metaphorical sentences only in English. As for the gesture axes, we found that individuals used the lateral and the sagittal axis equally frequently. Last, our participants' beat gestures were more congruent than incongruent with the metaphors accompanying them in both L1 and L2.

4.1 Comparisons of Gestures in L1 versus L2

Metaphors involve mapping concrete objects/domains onto abstract entities. How we process metaphors depends on their conventionality (Bowdle & Gentner, 2005). We carry out online mappings when we try to make sense of a novel metaphor. Conventional metaphors, on the other hand, are understood through access to the conventionalized pairs of meanings that became robust and automatic over time (Bowdle & Gentner, 2005). Thus, conventionality of a metaphor is of a central importance in terms of how we make sense of metaphors. We found a significant interaction of sentence type and L2 proficiency to predict conventionality ratings of sentences. On average, our participants rated L2 sentences as less conventional. Moreover, the participants with higher PPVT scores rated L1 and L2 metaphors, but not literal sentences, as more conventional. These two findings show that the language metaphors are processed in may be a factor associated with the conventionality assigned to metaphors. As hypothesized, more proficient L2 speakers found metaphors more conventional than less proficient L2 speakers. Interestingly, we find the same association between the PPVT scores and conventionality ratings in Turkish as well. There may be two reasons for this finding. First, the pattern may be due to chance. Second, it may be because of what PPVT measured in our sample. The association between PPVT scores and conventionality ratings was present only for metaphorical sentences. Therefore, we may think that PPVT might have tapped into a general linguistic ability that facilitates the processing of more complex metaphorical sentences, but not simpler literal sentences.

When considered together, findings of the previous studies (Chen et al., 2013) and the Career of Metaphor Model (Bowdle & Gentner) suggested that we should have found an interaction of sentence type and language to predict conventionality ratings given to sentences. This suggestion was following from the lack of conventionality difference between L1 literal sentences and conventional metaphors in L1, but L2 metaphors being more demanding than L2 literal sentences and L1 metaphors (Chen et al., 2013; Jankowiak et al., 2017). We did not find this interaction. However, this does not mean that there were not any conventionality differences between L1 and L2 metaphors or literal sentences. For this study, we picked metaphors with over 3.5/5 conventionality rating from a larger pool. Studies show that conventional metaphors and literal sentences did not differ much in terms of their conventionality especially in L1 (Bowdle & Gentner, 2005), and processing of L2 metaphors is modulated by L2 proficiency (Chen et al., 2013; Jankowiak et al., 2017). Supporting this L2 proficiency viewpoint, we did find that the more proficient participants rated metaphors as more conventional in L2. Moreover, a closer look into our nonsignificant sentence type and language interaction revealed that whereas our participants rated L1 metaphors and literal sentences similarly in terms of conventionality, they rated L2 metaphors as less conventional than L2 literal sentences with a high but significant p value. Furthermore, the conventionality rating difference between L1 and L2 metaphors were again in favor of our hypotheses with a p value slightly (+.01) over the significance threshold. This marginal significance may have been caused by the power loss we suffered due to our small sample size. As we already picked conventional metaphors for comparison, we needed high statistical power to detect the already attenuated conventionality difference between L1 and L2 metaphors. It is very likely that our three-way sentence type x language x PPVT interaction turned out to be nonsignificant for the same reason, $p=.09$. Therefore, we did not completely refute our hypothesis, presenting associations of language (and sentence type) and L2 proficiency with conventionality. A stimulus set that includes conventional metaphors along with newly created and rated novel metaphors in L1 and L2, or a larger sample size may show a strong interaction between language and sentence type as shown in the literature (Bowdle & Gentner, 2005; Jankowiak et al., 2017). Although the conventionality ratings did not differ significantly in our sample, we hypothesized that the English metaphors would be perceived as less conventional, based on the literature. Therefore, they would require more mappings of space onto time than their Turkish counterparts. This increased number of mappings could increase gesture frequency (total gesture use) while explaining English metaphors, as gestures serve self-oriented functions like activating, manipulating, exploring, and packaging spatial information (Kita et al., 2017). Taking this logic further, proficient L2 speakers would produce fewer gestures while explaining metaphors, as they would meet the increased mapping demands of L2 metaphors more easily. In L1, however, conventional metaphors and literal sentences do not differ much in terms of their conventionality. Moreover, we process conventional metaphors by accessing an abstract second sense of the base term (Bowdle & Gentner, 2005), as opposed to a concretely spatial content. Therefore, literal sentences in Turkish would be more spatial in terms of their content, and they should elicit more gestures because of this increased ‘spatiality’ (Alibali, 2005; Kita et al., 2017).

Supporting our hypotheses, we found that our participants produced more gestures while explaining literal sentences in Turkish and metaphorical sentences in

English. We also found that higher PPVT scores were associated with fewer gestures in English sentences than lower PPVT scores. These results were in line with our conventionality ratings model. In particular, the sentence type and language interaction in the model showed that L2 metaphors were less conventional than L2 literal sentences. Although the conventionality ratings did not differ between L1 literal and L1 metaphorical sentences, our participants produced more gestures while explaining L1 literal sentences. This finding indicates that L1 literal sentences may have elicited gestures due to their more concrete spatial content in the absence of a conventionality difference, as Alibali (2005) suggested.

An analysis of the total gestures, however, is too coarse to capture the differences between gesturing patterns across conditions. A closer look into the results reveals that although the findings supported our hypotheses, there was no association between the total numbers of gestures produced and the conventionality ratings they provided for the sentences. Furthermore, to claim that the differences between the total gestures are due to the mapping demands and spatial/metaphorical content of the sentences, we should see some differences in the numbers of iconic and temporal gestures as well. Iconic and temporal gestures are the primary types of gestures that depict concrete objects and actions, and spatial metaphors of time. Therefore, a difference in those gestures across conditions, as well as their relationship with L2 proficiency and conventionality ratings, would enable us to further support our hypothesis and link the differences to conventionality of metaphors. We found these differences in our temporal gestures model. Our participants produced more gestures while explaining L2 metaphors compared to both L1 metaphors. Our results are likely to be due to the conventionality differences between metaphors in L1 and L2, rather than a built-in factor specific to L1 or L2 metaphors. Özçalışkan (2014) showed that L1 and L2 speakers show similar developmental patterns in their ability to understand metaphors. Moreover, we used the same metaphors in L1 and L2 to keep the mappings stable across languages. Thus, we can say that our participants used gestures' self-oriented functions (Kita et al., 2017) to map space onto time when they needed to do that online because of the metaphors' decreased conventionality in L2.

In relation with the conventionality of the metaphors, we also hypothesized that individual L2-related differences would be associated with how we process metaphors and temporal gesture production. In terms of the L2-related individual differences, we found that higher L2 proficiency was associated with fewer temporal gestures in English sentences. This effect was modulated by sentence type and language in a marginal interaction such that higher PPVT scores were associated with fewer temporal gestures only for metaphorical sentences in both languages. The interaction was of marginal significance probably because literal sentences in either language elicited very few temporal gestures, making it look like a sentence type main effect rather than an interaction. As mentioned above, the association between L2 proficiency and temporal gesture production might have either been due to chance, or PPVT (a vocabulary assessment) having tapped into a general linguistic ability facilitating the processing of metaphors. With this finding, we further supported our hypothesis by showing an association of L2 proficiency with fewer temporal gestures. Moreover, we found an interaction between sentence type, L2 proficiency, and conventionality ratings as well. For the metaphors with conventionality ratings at the mean level and above, higher L2 proficiency was associated with fewer temporal gestures. This shows that both conventionality of a metaphor and L2 proficiency of an individual play a role in how we process and produce L2 spatial metaphors of time.

To summarize, the temporal gesture model seems to confirm our hypotheses about the gesture use while explaining L2 metaphors. Conventionality ratings did not seem to have a relationship and an interaction with all the other predictors. This might be due to two reasons: First, conventionality may not be the main actor here and the number of gestures may be related to something else along with the level of conventionality. Second, with a pilot sample before the study, we already picked the most conventional metaphors with 3.5/5 or higher conventionality ratings from a wider pool. In our study, mean conventionality ratings for L1 and L2 metaphors were 3.96 and 3.69, respectively. Thus, our stimuli set already consisted of conventional metaphors, and our participants rated already conventional metaphors on a scale of 1 to 5. Although some metaphors inevitably received conventionality ratings below the mean score, this does not mean that they were not conventional enough to require many mappings along a continuum with the metaphors over the mean on the other end. We may argue that a stimulus set with newly created novel metaphors along with conventional spatial metaphors of time can have a better chance of revealing a continuous association of conventionality ratings with temporal gesture use.

Our iconic gestures model showed that, like our total gestures model, the participants produced more iconic gestures in L1 literal sentences and L2 literal sentences. The three-way interaction among sentence type, PPVT, and conventionality ratings showed that those participants with higher PPVT scores produced fewer iconic gestures while explaining literal sentences that had conventionality ratings at the mean level or above. This interaction was present in the temporal gestures model as well. Along with L2 proficiency, conventionality ratings, although they were not associated with total gestures, are associated with the most affiliated types of gestures for literal and metaphorical sentences. Different from the temporal gestures, the conventionality and L2-proficiency interaction in iconic gestures may indicate a general facilitation in sentence explanations, which may have alleviated the need for depicting the spatial relationships or objects with gestures

Our beat gestures model yielded an interesting finding as well. We found that participants produced more beat gestures while explaining L2 metaphors compared to both L2 literal sentences and L1 metaphors. The pattern of their beat gesture production was similar to that of their temporal gestures. This finding is interesting as beat gestures have long been regarded as a different type both based on their lack of imagistic content and being biphasic, compared to triphasic iconic and metaphoric gestures (McNeill, 1992). To put it simply, the only important thing about beat gestures is that some low-energy movement with little or no internal structure takes place. However, beats show some bits of representational content and should be regarded as on a continuum with iconic gestures (McNeill, 1986). Although beat gestures are much simpler than representational gestures, they are not completely devoid of meaning. Supporting this idea, Casasanto (2008) showed that even meaningless simple motoric actions like moving marbles up or down are associated with the quality of what we remember in an experimental context. In the experiment, those who moved marbles upward retrieved more positive memories than those who moved them downward, consistent with the GOOD is UP metaphor. The foreshadowing by McNeill (1986) and results of Casasanto (2008) pave the way for linking simple motoric actions to the abstract concepts we think about. Our results support this argument as well. In our study, the most demanding stimuli were the L2 metaphors because of their mapping load. Compatibly, people produced more beat gestures while explaining them compared to any other group. Therefore, like Casasanto (2008), we may conclude that our results hint at the association of beat gestures with thinking in terms of abstract concepts, specifically the metaphorical content of the sentences in this study. Further studies are needed regarding beat gesture use in concrete and abstract contexts.

4.2 Hand Use

Our bimanual gesture hypothesis was partially supported by the data. Individuals' bimanual gesture patterns were consistent with the patterns of their total number of gestures. Similar to that model, people produced more bimanual gestures while explaining literal sentences in Turkish and metaphorical sentences in English. Argyriou and colleagues (2017) showed that left-hand involvement was observed during explaining metaphors, compared to literal sentences. They linked their results with the bilateral activation elicited by metaphors, such as the one in Chen et al. (2013). According to the reasoning of Argyriou and colleagues (2017), unlike literal linguistic stimuli, metaphors should elicit gesture production with both hands as they elicit activation from the right hemisphere as well. We found the same pattern in English but not in Turkish. This pattern might have emerged due to our stimuli characteristics as we already had conventional metaphors coming from a pilot study. The Career of Metaphor Model showed that conventional metaphors and literal sentences do not differ a lot in terms of conventionality in L1 (Bowdle & Gentner, 2005). Moreover, Yang (2014) showed in a meta-analysis that the right hemisphere showed a significant effect only when metaphors were novel. As the metaphors would be regarded more novel in English, obtaining more bimanual gesture would not be surprising.

4.3 Gesture Axes

We found that participants used the lateral and sagittal axes equally frequently while producing temporal gestures. This finding did not support our hypothesis about the possible dominance of lateral gestures and seems to contradict with previous research at first glance. For example, Cooperrider and Nuñez (2009) found that temporal gestures were mostly produced on the lateral axis, to the extent that they named their article 'transversal' temporal gestures. However, their experimental stimulus was a horizontally designed depiction of mankind's technological achievements from the Big Bang until today, which may have primed the participants to gesture on the lateral axes. Moreover, Casasanto and Jasmin (2012) found that lateral gestures are associated with the lack of sagittal prompts in the accompanying speech, even though they make up the majority of temporal gestures. In contrast, Bostan and colleagues (2016) found that Turkish speakers used the sagittal axis more frequently in their gestural expressions of time, mainly because they mostly used deictic metaphors and concepts of time like 'ahead' and 'future.' That is, although the lateral axis seems to be the dominant one for temporal gestures, the axis on which we gesture seem to be affiliated with the content of the speech (Bostan et al., 2016; Casasanto & Jasmin, 2012) or the visual stimuli (Cooperrider & Nuñez, 2009). To avoid the possible effects of speech content, we leveled the number of sentences with lateral and sagittal axes in this study. Conforming to this, and our interpretation of the literature, the participants used the lateral and sagittal axes equally frequently when the number of lateral and sagittal sentences were equal.

In addition to our total number of beat gesture findings, we found that our participants produced more congruent than incongruent beat gestures in metaphorical sentences. This shows that beat gestures may have some representational components (Casasanto, 2008). That is, although they have been regarded as nonrepresentational, beat gestures may have some affiliations with the accompanying speech content, especially in metaphorical contexts. A comprehensive stimulus set that uses different parts of space as metaphors for time may shed light on the nature of beat gestures as to how they relate to abstract concepts.

Chapter 5:
CONCLUSION

In this study, we compared the temporal gestures of L1-Turkish and L2-English bilinguals in relation with the language-driven processing differences between L1 and L2 spatial metaphors of time. We found differences in individuals' gesturing patterns as they explained literal and metaphorical sentences in L1 and L2. These differences were in line with the conventionality-based processing differences between L1 and L2 metaphors in the literature. We also found semi-parallel hand use and gesture axis results with previous studies. Our participants produced more bimanual gestures while explaining metaphors compared to literal sentences in L2 but not in L1. They also produced a similar number of temporal gestures on the lateral and the sagittal axes. Although our results are not conclusive, they hint at the role of conventionality of metaphors in how we process them and how we produce temporal gestures as we talk about them. This study can pave the way for a new line of research that considers conventionality of the metaphors more often to arrive at a comprehensive framework about how we process spatial metaphors of time and produce temporal gestures related to them.

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FOOTNOTES

[1]We refrained from comparing temporal gestures across sentence types whenever possible since the literal sentences elicited very few of them.

[2]We refrained from comparing iconic gestures across sentence types whenever possible since the metaphorical sentences elicited very few of them.

APPENDICES

Appendix A: Spatial Metaphors of Time and Turkish Translations

1) We are coming up on the summer vacation.

2) A joyful vacation lies ahead of us.

3) The vacation we all wait for is coming.

4) Summer vacation is coming up.

5) The concert day approaches with each moment.

6) We will reach the concert day in a month.

7)The new date of the concert will be announced in the coming days.

8) He wishes to turn back to the concert day.

9) We are yet to reach the exam day.

10) We are moving forward to the exam week.

11) The last exam of the semester is coming.

12) We have a party tomorrow, the exam follows behind.

13) The meeting is approaching.

14) We are moving onward to the meeting day.

15) The meeting will take place far from now.

16) There is an event tomorrow, the meeting follows close behind.

17)Time flies when you play this game.

18) He is proposing theories ahead of our time.

19) In some movies time moves backwards.

20) Compared to our time, these are some fossils from distant past.

21) The summer vacation was put back due to some unexpected events.

22) The classes ended earlier than expected, the summer vacation was put forward.

23) The concert has been put forward 2 weeks.

24)The concert date has been moved backward 4 days.

25) The final exam has been put back due to weather conditions.

26) The second exam was moved backward 2 days.

27) The meeting has been moved forward 3 days.

28) The grand meeting was put forward due to the new regulations.

29) The time of the event was put back due to a last minute issue.

30) The time of the speech was moved backward with an order.

1) Yaz tatiline yaklaşıyoruz.

2) Eğlenceli bir tatil önümüzde uzanıyor.

3) Beklediğimiz tatil geliyor.

4) Yaz tatili yaklaşıyor.

5) Konser günü her an yaklaşıyor.

6) Bir ay içinde konser gününe ulaşacağız.

7) Konserin yeni tarihi gelecek günlerde açıklanacak.

8) Konser gününe geri dönmek istiyor.

9) Sınav gününe ulaşmamıza daha var.

10) Sınav haftasına doğru ilerliyoruz.

11) Dönemin son sınavı geliyor.

12) Yarın bir partimiz var, arkasından sınav geliyor.

13) Toplantı yaklaşıyor.

14) Toplantı gününe doğru ilerliyoruz.

15) Toplantı şu andan uzakta gerçekleşecek.

16) Yarın bir etkinlik var, toplantı da hemen arkasından geliyor.

17) Bu oyunu oynarken zaman uçup gidiyor.

18) Zamanın ötesinde teoriler öneriyor.

19) Bazı filmlerde zaman geriye doğru akar.

20) Günümüze kıyasla, bunlar uzak geçmişten fosiller.

21)Yaz tatili beklenmeyen olaylar yüzünden 1 hafta ileri planlandı.

22)Dersler beklenenden erken bittiği için yaz tatili öne çekildi.

23)Konser 2 hafta ileri alındı.

24)Konser tarihi 4 gün öne alındı.

25)Final sınavı hava koşulları sebebiyle ileri alındı.

26)İkinci sınav 2 gün öne çekildi.

27)Toplantı 3 gün ileri alındı.

28)Büyük toplantı yeni düzenleme sebebiyle öne çekildi.

29)Etkinliğin saati (zamanı) son dakikada çıkan bir sorun nedeniyle ileri alındı.

30)Konuşmanın saati(zamanı) bir emirle öne çekildi.

Appendix B: Literal Sentences with Spatial Words and Turkish Translations

1)We are coming up on to my parents' house.

2)The map shows that there is a park ahead of me.

3)The car is coming.

4)The scheduled bus is coming towards the bus stop.

5)The running children are approaching us.

6)We will reach our destination soon.

7)The teacher who will be coming to the classroom is bringing the exams with her.

8)When I heard the noise, I turned back to see what it was.

9)There's still time for us to reach our destination.

10)We are moving forward our destination.

11)My friend is coming for dinner tonight.

12)The police car is following behind the ambulance.

13)The lion is approaching its prey.

14)We are moving onwards to the stage.

15)The shopping center is far from us.

16)The police are following closely behind the man.

17)Our plane is flying to the south.

18)They are ahead of us and they're going to arrive earlier than us.

19)The child's toy car broke, it is going backwards.

20)You can see the monument in the distance.

21)If you use something, you should put it back.

22)He put himself forward for the position.

23)She put her written theory forward for discussion

24)The dining table was moved backward.

25)Put the books back when you finish them.

26)The guard asked me to move backward.

27)He moved his car forward.

28)He put his written consent forward for consideration.

29)She knows she must put the pen back after using it.

30)He needs to move backward to get home.

1)Ailemin evine yaklaşıyoruz.

2)Harita önümde bir park olduğunu gösteriyor.

3)Araba yaklaşıyor.

4)Tarifeli otobüs durağa yaklaşıyor.

5)Koşan çocuklar bize yaklaşıyor.

6)Varış noktamıza yakında ulaşacağız.

7)Sınıfa gelecek olan öğretmen yanında sınavları da getiriyor.

8)Sesi duyunca geri dönüp ne olduğuna baktım.

9)Varış noktamıza ulaşmamıza daha var.

10)Varış noktamıza doğru ilerliyoruz.

11)Arkadaşım bu akşam yemeğe geliyor.

12)Ambulansın arkasından polis arabası geliyor.

13)Aslan avına yaklaşıyor.

14)Sahneye doğru ilerliyoruz.

15)Alışveriş merkezi bizden uzakta.

16)Polisler adamın hemen arkasından gidiyor.

17)Uçağımız güneye uçuyor.

18)Onlar bizim önümüzdeler ve bizden daha erken varacaklar.

19)Çocuğun oyuncak arabası kırılmış, geriye doğru hareket ediyor.

20)Uzakta bulunan anıtı görebilirsiniz.

21)Eğer bir şey kullanırsan onu geri koymalısın.

22)Açık pozisyon için kendini öne sürdü.

23)Yazılı teorisini tartışma için ileri sürdü.

24)Yemek masası geri alındı.

25)Kitapları bitirdiğinde geri koy.

26)Bekçi benden geriye doğru gitmemi istedi.

27)Arabasını ileri aldı.

28)Yazılı iznini gözden geçirilmesi için öne sürdü.

29)Kalemi kullandıktan sonra geri koyması gerektiğini biliyor.

30)Eve ulaşması için geriye doğru gitmesi gerekiyor.

Appendix C: Gesture Coding Scheme

Coding Category	Definitions and Examples
Sentence	The sentence that the participant is asked to explain. For example, “A joyful vacation lies ahead of us.” / “Eğlenceli bir tatil önümüzde uzanıyor.”
Sentence Axis	The axis implied in the sentence that the participant is asked to explain. This will only be coded for metaphorical sentences. For example, “A joyful vacation lies ahead of us.” / “Eğlenceli bir tatil önümüzde uzanıyor.” makes use of the sagittal axis with the word “ahead.” However, “Time flies when you play this game.” / “Bu oyunu oynarken zaman uçup gidiyor.” implies the lateral axis by not having a sagittal word.
Sentence Type	Sentences are coded either as metaphorical or literal. For example, “Time flies when you play this game.” / “Bu oyunu oynarken zaman uçup gidiyor.” is a metaphorical sentence, whereas “Our plane is flying to the south.” / “Uçağımız güneye uçuyor.” is a literal sentence.
Transcription	Verbatim transcription of the participant’s explanation of the given sentences.
Gesture	Every gesture will be marked as a gesture in this tier for a detailed coding in the subsequent tiers.

McNeill Type	All gestures will be coded for their type in the classification proposed by McNeill (1992). There are four types of gestures in the classification: Iconic, Pointing, Beat, and Metaphoric gestures. For example, while explaining the sentence “Our plane is flying to the south.” / “Uçağımız güneye uçuyor.”, if a participant shows the trajectory of the plane, or makes a plane shape with their hands, this will be an iconic gesture. If a participant points to south (or where she/he thinks is south), this will be a pointing gesture. Rhythmic movements of hands that accompany the speech will be coded as beat gestures. Last, if a participant depicts time’s movement with an arc of their hand while explaining the sentence, “Time flies when you play this game.” / “Bu oyunu oynarken zaman uçup gidiyor” this will be a metaphoric gesture in this classification and further coded in the other categories. Iconic and Pointing gestures will only be coded for literal sentence explanations, whereas Metaphoric gestures will only be coded for metaphorical sentence explanations unless a participant produces a concrete iconic/pointing gesture while explaining metaphorical sentences and a metaphorical gesture while explaining literal sentences. Beat gestures will be coded for both types of sentences.

Axis	Temporal gestures will be coded for their axis as Sagittal, Lateral, or Diagonal. If a gesture is produced on the front-back axis, it will be coded as a sagittal gesture, whereas if it is produced on the left-right axis it will be coded as a lateral gesture. Last, if a gesture is produced on any diagonal axis (e.g, forward leftward) it will be coded as a diagonal gesture.
Hand Use	All gestures will be coded for hand use as Right, Left, or Both.
Axis Congruency	Temporal gestures will be coded as congruent, half-congruent and incongruent according to the sentence's implied axis. Diagonal gestures will also be coded for congruency depending on their congruency with the narrative trajectory on the sagittal and lateral axes. For example, while explaining the sentence "A joyful vacation lies ahead of us." / "Eğlenceli bir tatil önümüzde uzanıyor." if the participant produces a forward gesture, it is a congruent gesture. If the participant produces a rightward and forward gesture, it will be a congruent diagonal gesture, whereas a rightward and backward, or a leftward and forward gesture will be a half-congruent diagonal gesture. If the participant produces a backward and leftward gesture it will be an incongruent diagonal gesture. Last, if the

	participant produces a backward gesture it will be an incongruent gesture as well.
Beat Congruency	Beat gestures will be coded for axis congruency in the same way as temporal gestures.