The Relationship between Handedness and Valence: A Gesture Comprehension Study

by

Esra Nur Çatak

A thesis submitted to the

Graduate School of Social Sciences and Humanities

in Partial Fulfillment of the Requirements for

the Degree of Master of Arts

in

Psychology

KOÇ UNIVERSITY

September, 2015

STATEMENT OF AUTHORSHIP

This thesis contains no material which has been accepted for any award or any other degree or diploma in any university or other institution. It is affirmed by the candidate that, to the best of her knowledge, the thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

Signed Esra Nur Çatak

ABSTRACT

According to the body specificity theory, the differences between people's bodies affect their mental representations of the world (Casasanto, 2009). People with different hand preferences assign positive and negative emotions to different sides of their bodies and they produce co-speech gestures with their dominant hand when the content is positive and non-dominant hand when the content is negative (Casasanto & Jasmin, 2010). Our study investigated if this side preference by handedness was also valid for gesture comprehension using eye gaze information. Participants watched faceless gesture videos with negative and positive content on eye-tracker. Our results indicated no difference in looking preferences with regard to being right- or left-handed. Yet, an effect of emotional valence was observed. Participants spent more time looking to the right (actor's left) when the information was positive and to the left (actor's right) when the information was negative. Additionally, a directionality effect from left to right was observed for the first three seconds of the videos regardless of handedness or valence. Finally, our gesture production task, which included participants re-telling of the negative and positive content while their spontaneous gestures were being videotaped revealed a handedness effect only for different types of gestures (representational vs. beat). Participants preferred to use their dominant hand more for beat gestures, however, for representational gestures while the right-handers used their right hand more, the left-handers gestured using both hands equally. Overall, our findings contradict the existing literature on the body specificity theory. Possible reasons for the opposing results will be discussed.

Keywords: handedness, body-specificity, gesture comprehension, gesture production

ÖZET

Vücuda özgünlük (Body specificity) teorisine göre kişiler etraftaki dünyayı farklı vücutlarla deneyimledikleri için bu iletişimlerden ortaya çıkacak değer yargıları da farklı olacaktır (Casasanto, 2009). Bu farklı iletişimlerden en yapısal ve düzenli olanlardan biri de kişilerin baskın el kullanımlarıdır. Kişilerin olumlu içerikli konuşmalar yaparken baskın elleriyle jest yaptıkları, olumsuz içerikli konuşurken ise baskın olmayan ellerini kullandıkları bulunmuştur (Casasanto & Jasmin, 2010). Bu çalışma, jest, baskın el ve duygusal değer yargıları arasındaki ilişkinin jestleri anlarken de kişilerce göz önünde bulundurulup bulundurulmadığını anlamak için yürütülmüştür. Katılımcılar göz-izleme (eye-tracker) yöntemiyle, pozitif ve negatif içerikli, yüz gösterilmeden çekilmiş jest videoları izlemişlerdir. Sonuçlarımız baskın el grupları arasında bir fark bulmamış, ancak olumlu ve olumsuz koşullar arasında; pozitif duyguları sağ tarafla, negatif duyguları ise sol tarafla eşleştiren genel bir duygusal değer etkisi gözlemlemiştir. Buna ek olarak, videoların ilk üç saniyesinde gözlemlenen, el tercihi veya duygusal özelliklerden bağımsız olarak soldan sağa yönelen bir yön etkisi bulunmuştur. Son olarak, katılımcılardan spontane jestleri kayıt altına alınırken izledikleri videoları tekrar anlatmaları istemiş ve jest üretimi sırasında katılımcılar arasında el kullanımı açısından el tercihine ya da duygusal değer özelliklerine bağlı bir fark gözlemlenmemiştir. Ancak el kullanımı jest türüne göre (temsili – ritim) incelendiğinde baskın el tercihinin etkisi gözlemlenmiştir. Katılımcılar, ritim jestleri yaparken baskın ellerini tercih ederlerken; temsili jest yaparlarken sadece sağ elini bakın kullanan grup sağ elini tercih etmiş, solaklar ellerini eşit sıklıkta kullanmışlardır. Genel olarak, çalışmamızda vücuda özgünlük teorisi üzerine yayınlamış önceki literatürle çelişen sonuçlar bulunmuştur. Bu çelişkiye etkisi olmuş olabilecek nedenler tartışılmıştır.

Anahtar Sözcükler: baskın el, jest üretimi, jest anlama, vücuda özgünlük

ACKNOWLEDGEMENTS

First of all I would like to express my gratitude to Dr. Tilbe Göksun for the guidance and mentoring through all steps of this research. Her patience and encouragement has been an irreplaceable source of support for the two years we spent together. I am grateful for the experience and knowledge I achieved working together which will definitely guide me in the future years to come.

Secondly, I would like to thank Dr. Aylin Küntay, Dr. Çağla Aydın and Dr. Alper Açık for being so supportive and responsive whenever I need guidance and for their precious comments which shaped this research.

Following, I want to thank my lab members and Başak Akdoğan for their generous support and help through the hard times of data collection. I also want to thank Aslıhan Bağcı, Benay Başkurt, Atakan Kaya and Melike Hazır for helping me with data collection and coding.

I am also grateful to the Scientific and Technological Research Council of Turkey (TÜBİTAK) for their financial support during my master studies.

My precious friends Ayşenur Karaduman -my gesturer- , Niloofar Akhavan –my statistician- , and Emel Burçin Kırmızı –my first participant- , their existence alone kept me going in the worst times and for that I can never thank them enough for being there for me in my time of need.

Finally, I want to thank my family, even though we were separated for these two years, I never once stopped feeling their sincere support. They are the reason for all my past and future success.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

«If thinking is embodied in this sense, then people with different kinds of bodies must think differently. That is, if concepts and word meanings are constituted in part by simulations of people's own perceptions and actions, then people with different bodily characteristics, who interact with their physical environments in systematically different ways, should form correspondingly different mental representations. I call this proposal the body-specificity hypothesis. » (Casasanto, 2009)

People all have unique, different bodies through which they experience the world. With this difference in experience variations in the representations of the world may appear. As these differences in interaction with physical environment are systematic and habitual, their effects on the representations of the owners become more predictable and stable (Casasanto, 2014).

The difference between right-handed and left-handed people is a simple model to investigate the body-specificity hypothesis. Hands are the most frequently used parts of the human body to interact with the environment. Right-handed and left-handed people differ in the ability to use both of their hands with the same effectiveness. This difference in dexterity will affect the comfort and the experience in the left or right side of the space they are operating in. According to the body-specificity theory (Casasanto, 2009), because left-handed and right-handed people interact with the outer world differently, their representations of the world may also vary. In line with this theory, the present study aims to investigate how people's hand preferences influence their comprehension of others' hand gestures that accompany different speech content. In particular, we ask whether (1) right- vs. left-handed people focus on one side of the body more than the other and (2) the extraction of information in gestures differ with the emotional content of stories.

1.1.Handedness and Valence Judgments

Through many cultures the right side is often paired with goodness, while left side of the space is paired with badness. Many different languages are full of different sayings such as “right hand man” (for important people) or “having two left feet” (for clumsy people). Even in Turkish the word right *“sağ”* means alive while left *“sol”* means to decay. Is this pairing of valence with sides is a universally established pattern that is similar for everyone or could this be a result of right-handed people being the majority of the world’s population?

To explain the mechanism behind this association of valence with space -whether it is a body-specific mapping or simply a cultural phenomenon- a series of experiments were conducted. For example, when English-speaking participants were given two animals to place in the boxes around a character –Bob-, they placed the animal they liked to the left or right of the character according to their own hand preferences; this procedure was called *the bob experiment* (Casasanto, 2009). In particular, left-handers placed the “good” animal to the left side and “bad” animal to the right side of the cartoon character most of the time, while right-handers did the opposite. However, when participants were asked to place the animal either above or below the character the hand preference did not matter. Mostly participants preferred to place the animal they liked in the box above and the other animal in the box below. The study was later replicated in a different culture with Dutch participants to see if people were aware of their choices of placement. Using the same procedure and questions, the results of this follow-up study pointed out that 99% of the participants were not aware of the purpose of the experiment, meaning that the hypothesized relationship between handedness and valence judgment may not be dependent on people’s awareness and could occur unconsciously. A control study ruled out the possibility that the results were because of participants’ use of their hands to draw the animals to the boxes they see fit. Participants significantly chose to place the good animal in the box congruent with their dominant side, even without using their hands. Furthermore, using the same method, Fuente, Casasanto, Román and Santiago (2014) tested Moroccan and Spanish right-handed participants. While Moroccan culture is more salient in “right is good” bias compared to Spanish culture, participants of the two countries produced similar patterns for the procedure. These findings present no evidence for a cross-cultural difference.

Continuing to explore the link between valence and space judgments depending on handedness, Casasanto (2009) experimented using a new procedure that let people assign good and bad stimuli to spatial locations in an implicit manner. Thus, participants were asked to choose from one of two “aliens” they see for the first time, indicating a judgment on four personal characteristics (i.e. intelligence, attractiveness, honesty, happiness). These aliens were located either on the left or right side of the paper they were given and the questions were written in the middle. The results indicated that the location of the aliens presented were influential in participants’ judgments of personal characteristics that differed according to the hand preference. Consequently, among the participants who displayed a directional preference, while right-handed people were more likely to assign good qualities to the aliens on the right side of the paper, showing a “right is good” bias left-handed participants mostly decided that good qualities belong to the aliens on the left of the paper therefore showing a “left is good” bias. Finally, to see the effect of handedness and spatial location on valence judgments of everyday objects which are familiar and have preexisting values, participants were asked to make valence judgments on brief verbal descriptions of job applicants (in the job task) and familiar products that might be advertised in a newspaper or website (in the shopping task). The procedure was almost the same with the previous task but the aliens were replaced by either job applicants or products and participants were asked to hire one of the applicants from either side of the paper or decide to purchase one of the product items. Casasanto’s final experiment (2009) also yielded similar results: the right-handers were more than twice as likely as left-handers to attribute more positive characteristics to people or products described on the right side of the page demonstrating that implicit body-specific preferences were present in real world choices supporting the results of the prior experiments. These findings support the idea that people with different kinds of bodies experience their physical environments in systematically different ways and consequently form different mental representations, even in abstract domains.

Does the body specificity effect only relate to the genetic handedness or can it be established only by motor experience? To examine these questions, Casasanto and Chrysikou (2011) tested patients with weakness or paralysis on one side of their body due to unilateral cerebrovascular accident. These patients were asked to complete the good and bad animal locating task to see the effects of long-term changes in motor fluency. The patients who remained right-handed post stroke all selected the right box for the “good animal” while patients who turned left-handed post stroke chose left box for the “good animal,” which was not congruent with their premorbid right-handedness. These findings indicate that the association between valence and space is not due to the natural handedness, but may be a result of acting more fluently on one’s dominant side. In a follow up experiment, healthy individuals were turned into left- or right-handers by the experimenters to see whether the results could be the consequence of long-term neural organization due to stroke. A two-part training experiment with healthy right-handers was conducted by Casasanto and Chrysikou (2011). In the first part, a motor fluency task was completed with a ski glove either on the right or left hand of the participant. The second part was the bob task with the animal locating. Overall, participants tended to put the good animal to the box on the side congruent with the participants’ available hand side during the training phase compared to the side of the hand that had been gloved. Thus, changing people’s use of hands even with a brief motor task could lead to a change in their mental representations of valence and space.

People seem to associate goodness with their dominant side whether it has a long- or short-term dominance. Do these associations overreach the situations in which people have to use perspective taking? Do people only associate goodness with their own dominant side or are they able to take perspectives of others based on observed or expected bodily characteristics? Kominsky and Casasanto (2013) asked participants to complete *the bob task* used by Casasanto (2009). When people shared the perspective with the character, most of the right-handed participants chose to place the good animal to the animal's and their own right. In the opposite perspective condition, however, when the character was presented facing the participants, they successfully took the character's point of view and leaned towards placing the good animal to the characters right, which was their left side. Moreover, the effect was much more robust when they replicated the study with a real human photograph instead of a drawing of a character. It seems that people not only associate goodness to their own right but can consider another person's perspective in judging valence for them. One other question to be answered about the perspective-taking task is whether people consider their own bodily characteristics during perspective taking of others'. The experiment with the human photographs was replicated with a modification, the person in the photographs was wearing a sling on either his right or left arm, making him either right- or left-handed functionally. The results revealed that participants indeed were taking perspective during valence judgments considering the other person's bodily state and not projecting their own bodily characteristics onto others.

However, when perspective taking is coupled with vicarious motor experience, rather than taking perspectives people were more affected by the fluency component. Specifically, de la Fuente et al. (2015) made right-handed participants watch right-handed actors complete a motor task by wearing a ski glove in one hand. When both actors and observers completed *the bob task*, their views on the bad and the good sides were different. Actors put the good animal to their short-term fluent side (left), and the bad animal to their ski-gloved side (right) replicating the earlier Casasanto and Chrysikou (2011) study. In contrast, observers who watched the motor task phase facing the actors, put the good animal to the opposite of the actors. They failed to take perspectives and returned to their original good-is-right judgment as the vicarious motor experience strengthened their judgment. These results indicate that the judgments on left and right as good or bad could be a result of specifics of both others' and our own bodies.

The body-specificity hypothesis was also investigated using different formats such as brain imaging, reaction time studies, and memory performance. Willems, Hagoort and Casasanto (2010) used fMRI techniques to see if there was hemispheric activation difference for left- or right-handed people during lexical decision and mental imagery tasks with manual action verbs; such as throw and grasp. Indeed there was a difference between participants with different hand preference supporting the body-specificity theory. For each group the activated brain areas were in the hemisphere contralateral to their dominant hand; premotor areas during lexical decision task and both premotor cortex and primary motor cortex during mental imagery task (Willems et al., 2010). Memory performance was another area, which was found to be affected by handedness. Handedness and valence interacted to create heuristics for people when they were not sure of their memory performance. In particular, right-handed people tended to remember events on a difficult map more to the right side if the event was positive and more to the left side if the event was negative. The opposite was true for left-handed people. Also this effect was more salient as the handedness of the participants got stronger (Brunye, Gardony, Mahoney & Taylor, 2012).

For the reaction time and emotion discrimination studies the results are more complicated. Earlier studies (Van Strien & Van Beek, 2000; Rodway, Wright & Hardie, 2003) found no handedness effect in discriminating emotional faces presented either left or right side of the screen. In a recent study, a lexical decision reaction time procedure was used to see the association between handedness and emotional value of the words used in the task, in which participants were unaware of the valence property (de la Vega, De Filippis, Lachmair, Dudschig, & Kaup, 2012). When people were explicitly made to reason the valence judgment and side mapping, an interaction between handedness and emotional valence was present. Yet, when no explicit valence-side mapping instruction was given, the valence judgments on their own failed to activate the association between valence and response side (de la Vega et al., 2012). However, another reaction time study was successful in presenting an interaction of hand preference of people and emotional valence of words and faces. Right-handed participants were faster to react to positive stimuli with their right hands and negative ones with their left hands. The opposite was true for left-handed participants (Kong, 2013). Finally, another reaction time study investigated whether it was the hands or the sides that were associated with valence directly. They made participants cross their hands to make valence judgments and found that even on the other side of the body the dominant hand was important to associate with positive valence (de la Vega, Dudschig, De Filippis, Lachmair, & Kaup, 2013). Thus, even though there are some conflicting results, the literature strongly supports body-specificity theory on handedness and emotional valence relationship.

1.2. Gestures in the Body Specificity Theory

The body specificity theory is not confined only to one’s own body, but can expand to our social relationships with others and how we view the perspectives of other people around us (e.g., Kominsky & Casasanto, 2013). One possible way to examine the relation between handedness and judgments is through the use of hand gestures.

Gestures are an important part of face-to-face communication. During a conversation, speakers spontaneously produce hand movements that support certain aspects of the speech content. When these gestures form a close relationship to the content of speech including shapes, actions, events that are mentioned in the speech, they are classified as *iconic* gestures. Another gesture type related to accompanying speech is deictic gestures that are pointing movements (McNeill, 1992). Along with the iconic and deictic gestures, the present study will focus on *beat* type gestures that are movements without a meaning and prototypical in terms of movement characteristics. They are usually slow, low energy, rapid flicks taking place wherever the hand happens to rest (McNeill, 1992). The investigation of both types of gestures is necessary since representational gestures (iconic and deictic) and beat gestures differ in the way they carry information related to the speech.

Speech and gesture form a coherent language system. Various studies investigating the role of gestures during speech agree on the facilitative effect of gestures on speech (Riseborough, 1981; Kelly, Barr, Church, & Lynch, 1999; Sueyoshi & Hardison, 2005). For example, Riseboroug (1981) investigated the effect of gestures during speech with native speakers of English and found that the same story was retrieved better when accompanied with gestures even when the noise level in the environment was high. Same results were later obtained by Kelly et al. (1999), supporting memory enhancement in speech content when delivered with gestures. Additionally, they claimed that gesture was not an addition to speech but rather the two were interactive. Speech and gesture mutually disambiguated each other during a conversation. Furthermore, participants were less accurate in identifying an action when it was presented to them with incongruent speech and gesture (Kelly et al., 2009). These findings indicate that both speech and gesture affect each other interactively.

This interaction was also supported by neural studies. Kelly, Kravitz and Hopkins (2004) measured event related potentials of speech while participants were presented with audio-visual stimuli. They found that gestures indeed affected the processing of speech. The responses of the brain were different from the speech when accompanied by matching gestures compared to when accompanied by either mismatching or complementary gestures. The difference was not only caused by the addition of visual input of gestures, but by the *content* of the gestures. Another neural study demonstrates that the posterior end of the superior temporal sulcus and the adjacent superior temporal gyrus (pSTS/STG) in both hemispheres are responsible for the integration task (Holle, Obleser, Rueschemeyer, & Gunter, 2010). Additionally, they found that the activity in the left pSTS/STG was increased when the speech was hard to comprehend without the gesture. Thus, this area could play an important role in facilitating speech with gestures. Finally, Driskel and Radtke (2003) extended the research on the gestures, showing that gestures not only aided the comprehension but at the same time the speech production. People were much better in explaining different contents with gestures and in turn recipients of this explanation were much better in coming up with answers when they were given the gesture information with speech.

Although these studies about the speech-gesture interaction are informative, we need to ask how gestures interact with valence and handedness. A recent study analyzed presidential election speech videos with two right-handed and two left-handed candidates (Kerry, Bush being right-handed; Obama, McCain being left-handed) (Casasanto & Jasmin, 2010). The analyses revealed that the valence presented in speech was associated differently for left- and right-handed candidates in gesture. Both left-handed candidates tended to use their dominant hand during the speech containing positive valence clauses and non-dominant hands while they were producing negative valence clauses. The opposite pattern was present in the other right-handed candidates. These results noticeably support the body specificity hypothesis and extend it through a probability of communicative purpose. Speakers may provide the listeners how they feel about the content of the speech they are producing at the moment with probably unintended cues such as communicative gestures.

1.3. The present study

It is evident that left- and right-handers do not have the same vision of the world. The present study aims to investigate further to see how different people comprehend others depending on their own handedness. We aim to see the relationship between the valence and handedness using gestures in an experimental setting. We ask 2 main questions: (1) Do people perceive positive and negative emotional events that are depicted in left vs. right hand differently according to their hand preference? (2) How will they, in turn, express this information in their gestures? As in line with the body specificity theory, we hypothesize that right-handed people will be more likely to attend towards the right hand of the speaker during positive narratives and to the left hand during the negative ones. For left-handed people we expect the reversed pattern, however, the pattern could be weaker due to the pre-experimental exposure to right-handed people (as right-handed people being the majority in the population). Finally, we predict that when later asked to reproduce the narratives, people will use their dominant hand more if the content is positive and non-dominant hand if the content is negative.

CHAPTER 2

METHODS

2.1. Participants

A total of 66 students from Koç University volunteered to participate in the study for monetary award. Twenty-six of the participants were excluded: 7 of them was lost due to recording problems during eye-tracking, 16 participants failed to fulfill the descriptions given at the beginning of the sessions (e.g., looking only to the neck or one point on the screen not paying attention to the videos for the full session, or not looking at all), and finally 2 participants were discarded due to being ambidextrous. The final sample consisted of 40 participants, (19 left-handed, 27 females, Mage= 22.65, SDage= 2.8, age range: 19-29), who were given an informed-consent stating that they were free to leave whenever they wanted and that their information would be kept undisclosed to others who were not a part of the research project. All participants were Turkish native speakers.

2.2. Measures

Tobii T120 eye tracker with a data-sampling rate of 60 Hz was used to record participants' eye movements approximately for every 16 milliseconds. The Tobii Studio 3.2.1 was used to obtain the gaze data for the gesture videos. The data recorded by the eye tracker decoded into Areas of Interest (AOI) using Tobii Studio. For the AOIs, the screen was divided into two that included equal space to right and left from the midpoint. In addition to the whole video, the instances where the gestures include both hands were analyzed separately with different AOI groups.

In addition to the eye tracker gaze data, people were recorded with a camera throughout the session and after each video they were asked to retell the story. Spontaneous gestures during retelling were analyzed later for the hand preference and content. At the end of the procedure participants completed the Edinburgh Handedness Inventory (EHI) (Oldfield, 1971).

2.3. Materials and Procedure

The testing procedure took place in a silent room for approximately 15 minutes for each participant. The participants were required to sit on an armless chair in front of the eye tracker. Before the testing started the procedure was once again clarified for the participants and they completed the 9-point calibration process for the eye tracker to ensure a proper recording of the eyes. During this procedure, the eye tracker measures the characteristics of the participant's eyes and uses them to create an eye model to calculate the gaze data. After calibration, the participants saw negative and positive videos in a randomized order.

Participants watched a total of 6 videos; half of which were negative and the other half were positive. The positive event narrations included a birthday celebration, a picnic and a volleyball victory. The negative narrations consisted of a car accident, failing a class and a quarrel between roommates. The titles of these stories were presented to the participants before each video to initiate the intended emotions from the start. The narration texts were previously rated by 23 native Turkish university students. These independent raters saw the texts of 8 stories in two different randomized orders and rated the stories -3 (extremely negative) to 3 (extremely positive) with 0 meaning neutral. The final 6 stories were selected based on the agreement among the participants. Stories rated above +/- 1.5 averages were included. Two other stories, which were about a wedding and a sickness, were excluded due to being underrated for the intended emotion.

All videos were recorded with the same person as the gesturer and narrator. She wore dark clothing to contrast the hands and her face was not included in the screen. The recording took place in front of a white wall with no other distractions (see Figure 1). The narrator made a total of 6 gestures for each video including **3 types of hand use**: only left, only right, and both hands. The gestures including both hands were separately analyzed for gaze information.

The length of the videos was kept similar to each other to last between 20-30 seconds for each narrative. Figure 1 displays the use of different gestures (object and action) for 3 types of hand use in different scenarios (see below for the use of gestures in the scenario). For the same story texts, speech was accompanied by **3 types of gesture conditions**: *object gestures* (static gesture referring to objects), *action gestures* (dynamic gestures referring to actions) or without gestures as speech only condition.

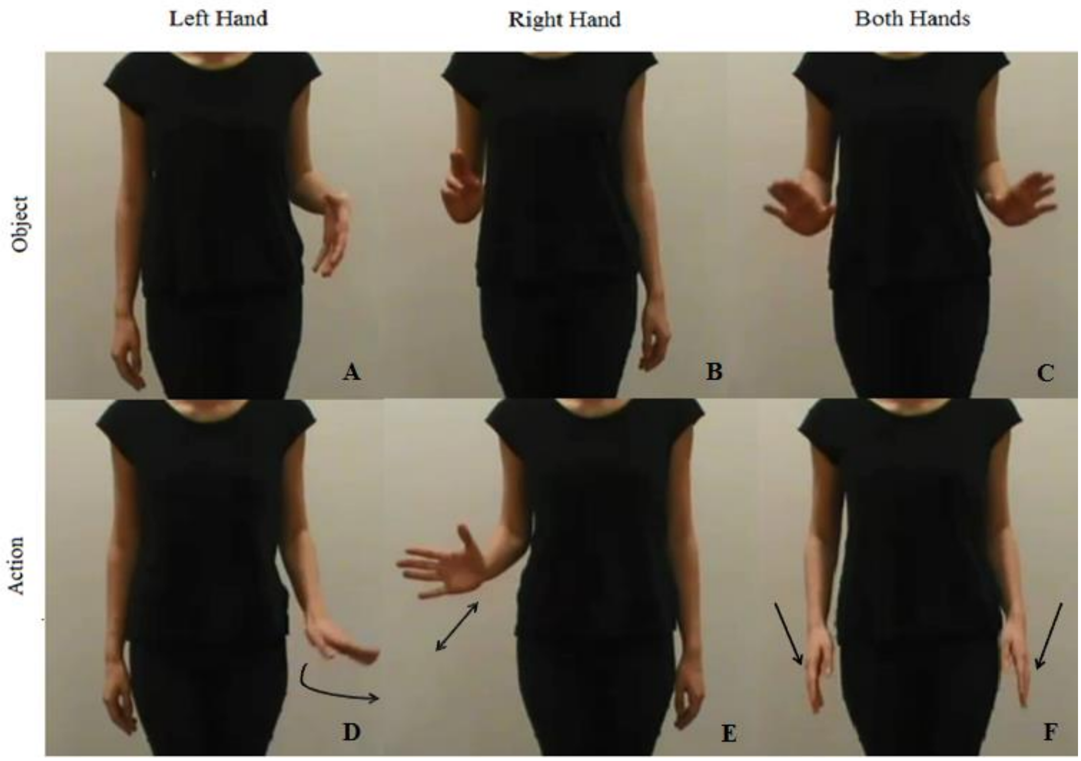

Figure 1. Examples of gestures for different conditions. The overlapping speech with all the gestures can be read just below.

For example, in the same story text for the “Car accident” scenario, in all videos for object, action, and beat gestures, the participant heard:

"Bu günlerde çok şanssızım. Daha yeni kar yağdığı için yollar buz tutmuştu. Biz de dün yolda giderken (Figure 1F) kaza yaptık. Kar lastiğini (Figure 1A) henüz takmadığım için araba kaydı (Figure 1D). Trafik lambasına (Figure 1B) geldiğimizde önümüzdeki arabaya çarptık (Figure 1E). Arabanın kaportası tamamen çöktü farlar kırıldı. Keşke hava yastığı (Figure 1C) patlasaydı, biz de bu kadar ciddi yaralanmazdık."

"I am so unlucky lately. Because it snowed recently, the roads were icy. So we had a car crash while driving (Figure 1F) *on the road yesterday. Because I did not install the snow tire (*Figure 1A) *yet, the car slid* (Figure 1D). *At the traffic lights* (Figure 1B) *we crashed* (Figure 1E) *the car in front of us. The hood of the card dented in and our headlights broke. I wish the airbags* (Figure 1C) *had deployed we wouldn't be as seriously wounded as we are."* (See Appendix A for the Scripts of all stories)

For different conditions the participants saw different gestures in the same sentence. For example, for the sentence "Dün yolda giderken kaza yaptık" ('*We had a car crash while driving on the road yesterday'*) the participant saw a gesture accompanying "yolda" (*'on the road'* gesture: <u>both hand fingers pointing forward move to sides and down</u>) in the **object condition** and for the **action condition** they saw a gesture accompanying "giderken" (*'while driving'* gesture: <u>both hands moving forward with index and middle fingers pointing down and alternate extending</u>). Additionally, there was a speech only condition without any gestures as a control. The participants viewed these three different types of videos in a randomized order and they watched the video for each text once in only one of the 3 conditions (*object gestures, action gestures,* or *speech only*) (see Table 1 for a sample video presentation to one participant).

Table 1.: Sample combination of videos for one participant

Gesture types	Positive Content	Negative Content
Object	A birthday celebration	A car accident
Action	A volleyball victory	Failing a class
Speech only	A picnic	A quarrel

At the beginning of the procedure, as a cover story, the participants were told that this was a memory study for emotional valence and asked to watch the video carefully to later answer some questions about the narratives. After each video, participants were asked to retell the story in their own words while their spontaneous gestures were recorded. They were not aware of the true purpose of the recording. Finally, participants completed the handedness inventory to assess their level of handedness at the end of the session with a demographic form. They were also asked to tell their own idea about the handedness of the gesturer.

2.4. Data coding

2.4.1. Eye-gaze data. For the whole direction of gaze information, we divided the screen into two Areas of Interests (AOIs), having two identical halves. The AOIs for left and right started when the narration began and lasted until the end of the videos. Later, we exported the visit duration data for the whole video AOIs. For each video we calculated the percentage of looking times to the left and right sides. As the looking times sum up to 100, we conducted analyses on the left side data only.

For the gestures including both hands, first the AOIs were drawn to left and right sides from the exact start of the gestures to 1 second after gesture finished. Participants were slow in reacting to hands and they kept paying attention to one of them after the both-hand gesture finished until another gesture starts. Thus, one second after the end of the both-hand gestures was also included in AOIs. Then, the looking times for the left and right AOIs were calculated. The analyses were again conducted only for the left side.

2.4.2. Story retelling data. From the speech data, we coded how accurate participants recalled the content of the story. We looked for the information supported by gestures in each story in participants' own speech and if half of information in the stories reinforced by gestures was expressed (from 3 out of 6 gestures) the session regarded as accurate.

Spontaneous gestures were coded for the hand use during gesturing. Again, the right-handed and left-handed groups were compared to each other in valence and control conditions for speech and spontaneous gesture data. Gestures of each participant were coded as iconic (static, dynamic), pointing or beat with the hand preference information. Later, for positive and negative stories, gestures used by the left, right or both hands were counted. Gestures performed with both hands were not included in the analyses, as they did not provide us with any information other than the participants' general gesturing tendency. The remaining one-hand gestures were analyzed, coupling with the accuracy data acquired from speech analyses. Gestures for negative and positive stories were analyzed separately.

2.5. Reliability

The gestures were coded by two independent coders and to establish reliability a third coder coded the whole sessions of 10 out of 36 participants (28%); 5 from each independent coder. The agreement for the total number of gestures present was 99.5% between coders. The agreement between coders for gesture to be classified as beat was 99% and for representative gesture classification coders agreed 98.5%.

2.6. Control Experiment: Mirror condition

Following up the experiment, a control condition was run to assess for the possible effects of the gesturer's real-life handedness, and also for the possible differences among one-handed gestures. The gesturer in the videos was right-handed. To eliminate the effect of her dexterity difference between sides to the gestures she made, we mirrored the videos and repeated the earlier experiment with an additional group of right-handed participants.

2.6.1. Participants. An additional 24 right-handed participants were volunteered to join the second part of the study for monetary reward. Due to problems in data collection 5 of them were excluded leaving 19 right-handed participants (12 females; Mage= 22.37, SDage=2.3, age range: 19 -28). The participants were given an informed-consent stating that they are free to leave whenever they wanted and that their information will be kept undisclosed to others who are not a part of the research project. All participants were native Turkish speakers.

*2.6.2. Procedure***.** The procedure was the same except the videos were mirrored but shown in the exact order.

CHAPTER 3

RESULTS

3.1. Looking times in the entire videos

To examine the total gaze duration for the right and left AOIs of videos with gestures, a three-way mixed ANOVA was performed. The handedness of the participants and the participants' idea on the handedness of the gesturer were independent variables with the looking time for negative and positive events were dependent variables. The results yielded neither significant main effects nor any interactions between the variables (*p*s > .05). Correlations conducted with handedness as a continuous variable was not significant, either (*p*s > .05).

No video order effect was significant between 3 randomized conditions (*p*s > .05).

3.2. Speech videos vs. gesture videos

For the effect of the presence of gestures, we compared the speech only videos with their same affect counterparts (positive videos with positive only speech videos and same for negatives). For positive videos, we found a main effect of gesture presence, $F(1,38) = 5.81$, $p = .02$, $\eta 2 = .13$ (see Figure 2). Without any group difference in handedness, all participants spent more time looking at the right side of the screen when there were gestures present, compared to the speech only videos.

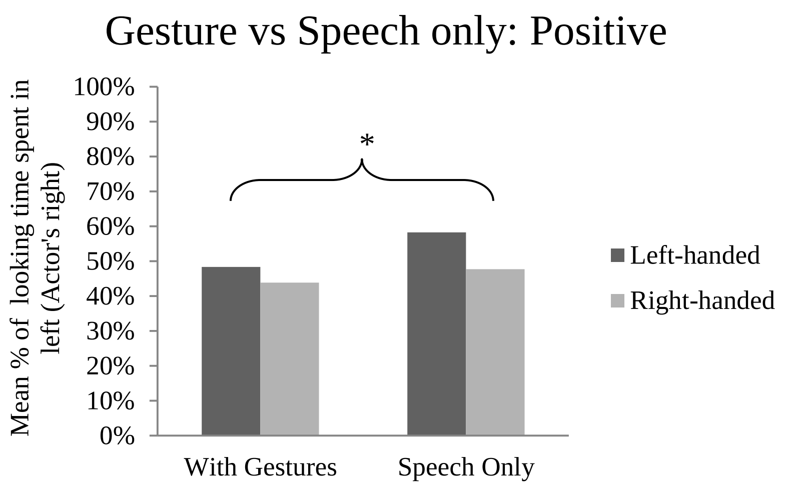

Figure 2. The mean percentages of mean looking time spent in the left side of the screen (actor's right hand side) for positive gesture or speech only conditions. *p < .05.

For negative videos, the main effect of the presence of gesture was also significant in visit duration to the AOI sides, $F(1,38) = 4.937$, $p = .032$, $\eta 2 = .115$ (see Figure 3). The main effect of other handedness or the interactions failed to reach significance (ps > .05).

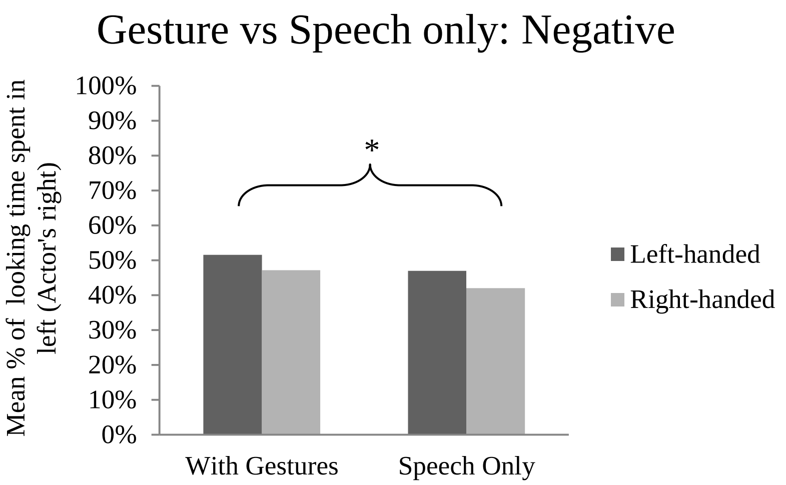

Figure 3. The mean percentages of mean looking time spent in the left side of the screen (actor's right hand side) for negative gesture or speech only conditions. *p < .05.

3.3. Looking times in both-hand gestures

For only both-hand gestures, a three-way mixed ANOVA on handedness of the participants, gesturer's handedness idea and the visit duration on the left side of videos with different affect duration as repeated measures showed a significant main effect of video negativity or positivity, $F(1,36) = 4.299$, $p = .045$, $\eta 2 = .107$. As shown in Figure 4, people spent more time looking at the left side while watching negative both-handed gestures than when the video content was positive. No main effect for participant handedness or the gesturer handedness and interactions among the variables were obtained (ps>.05). Correlations conducted with handedness as a continuous variable was not significant, either (ps > .05).

However, this significant effect was lost when the after-effect of one second was excluded, p>.05. Also, when the actor-handedness idea was not included into the analyses due to unequal group size (actor was left-handed: n=12, actor was right-handed: n=28), the effect of emotional valence on the looking duration was not significant, p>.05.

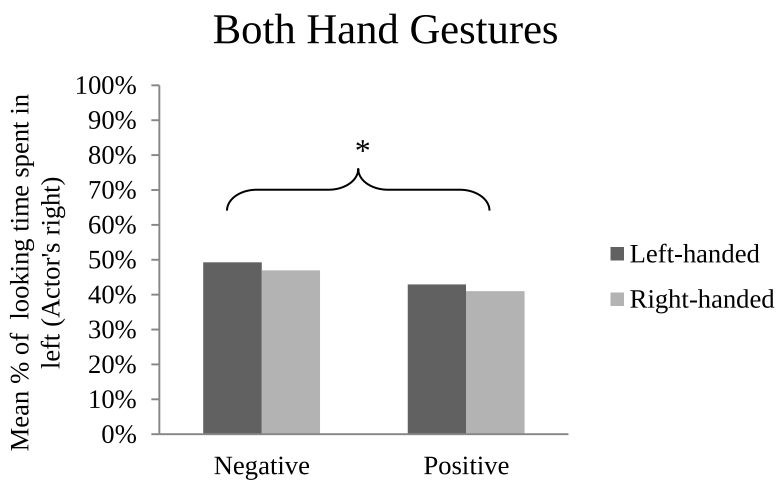

Figure 4. The mean percentages of mean looking time spent in the left side of the screen (actor's right hand side) only for both-handed gestures for positive and negative conditions. *p < .05.

3.4. First three seconds of the videos

For a more detailed analysis, the first three seconds of the videos were examined for the time spent looking to the left side. There were no gestures present for the first three seconds of the videos. The mixed ANOVA results for the first second indicated no significant difference between negative or positive videos as well as no effect of handedness (*p*s>.05).

To compare the first three seconds, we collapsed the speech only videos and videos with gestures together. For both negative and positive videos, the first three seconds were significantly different from each other in visit time to the left side, $F(1.23,46.55) = 10.256$, $p = .001$, $\eta 2 = .213$ and $F(1.23,46.64) = 11,198$, $p = .001$, $\eta 2 = .228$, respectively[1]. While the participants looked at the left side more than the right side in the first second (Mnegative=56% vs. Mpositive=56%), the time spent in the left side decreased significantly through second (Mnegative=52%, Mpositive=50%) and third seconds (Mnegative=49%, Mpositive=46%) (see Figure 5). There was no group difference between left-handed and right-handed participants.

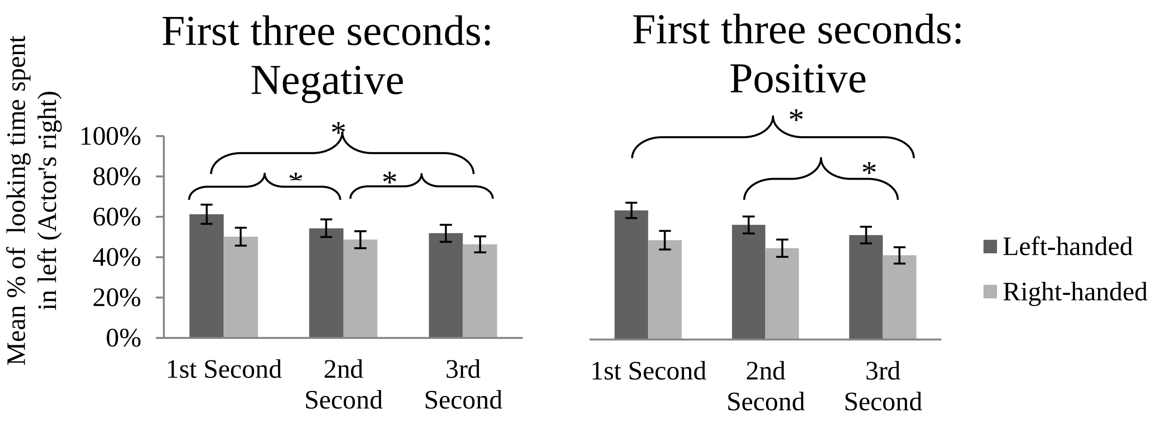

Figure 5. The mean percentages of mean looking time spent in left side of the screen (actor's right hand side) for first three seconds of the negative and positive videos. $*p < .05$.

[1] Mauchly's test indicated that the assumption of sphericity had been violated (positive condition: $\chi 2(2) = 36.73$, $p = .001$; negative condition: $\chi 2(2) = 37.06$, $p = .001$), therefore the degrees of freedom were corrected using Greenhouse-Geisser correction ($\varepsilon<.75$).

3.5. Control experiment: Mirror condition

We compared the AOI visit duration data from the right-handed participants of the previous analyses and a new group of right-handed participants who watched the mirrored version of the same videos. A mixed ANOVA results indicated no effect of condition (mirror vs. original) on the left looking duration for the whole video and also for only both-handed gesture AOIs (*p*s>.05). The actor handedness idea by condition was however significant, $\chi 2$ (1, *N* = 40) = 6.81, *p* = .012. While in the original condition only 38.1% of the participants thought that the gesturer was left-handed, in the mirror condition 78.9% of the participants thought the gesturer was left-handed.

3.6. Story retelling: Speech and gesture production

For speech, overall accuracy for retelling the stories was 64%, and accuracy information from speech had no effect on our results. Thus, we did not account for accuracy in the following analyses.

A total of 965 gestures from 36 participants were obtained. 4 participants produced no gestures through the session and excluded from the analyses. There was no significant difference in producing both-handed (41%) and one-handed gestures (59%), $p<.05$.

The percentage of left- and right-hand gestures differed by handedness; both groups preferred to use their dominant hand for one-handed gestures, $\chi 2$ (1, *N* = 574) = 64.9, *p* = .001. The left-handed participants used their left hand for 64% of the one-handed gestures whereas right-handed participants used their right hand for 70% of their gestures regardless of emotional valence.

For a more detailed analysis, we analyzed beat and representational gestures (iconic and pointing together) separately for hand use by handedness groups. A total of 470 beat gestures were produced during retelling task: 244 of these gestures came from the left-handed participants and 226 from the right-handed participants. The percentage of the right- vs. left-handed beat gestures differed by handedness, $\chi 2$ (1, N = 470) = 69.9, p = .001. The left-handed participants used their left hands for 73% of the beat gestures while the right-handed participants preferred to use their right hand for 65% of the one-handed beat gestures.

We coded a total of 117 one-handed representational gestures: 42 of them were produced by the left-handed participants and 75 gestures were produced by the right-handed participants. The use of left vs. right hand by groups was significantly different, $\chi 2$ (1, N = 117) = 9.0, p = .002. For the right-handed group, 83% of the representational gestures was produced by the dominant right hand, however there was no hand preference in the left-handed group, almost only half (% 43) of the representational gestures were produced by left hand.

CHAPTER 4

DISCUSSION

The body specificity hypothesis claims that the differences between people's bodies affect their mental representations (Casasanto, 2009). More specifically, people with different hand preferences form emotional mental representations for their dominant hand-side as a product of experiencing better fluency. In this paper, we investigated whether individuals' handedness had an effect on perceiving positive and negative emotional events that are depicted in gestures. We also asked whether people would in turn express similar information in their gestures. Based on the findings from the earlier studies on the body specificity theory, we hypothesized that (1) there would be a difference in the way people recruit information during a conversation according to their hand preference and the emotional value of the videos, and (2) people would differ in reproducing this information in gestures according to their handedness and the emotional valence.

Our results indicated no difference for the hand preference. The left-handed and right-handed people displayed no dissimilarity of preference to the left or right side looking for positive or negative emotional valence videos. However, we found an effect of emotional valence on the visit duration to sides regardless of handedness. Additionally, there was a directionality effect for the first three seconds of the stimuli regardless of handedness or emotional valence. Lastly, for the gesture production, we found that right- and left-handed groups had differences in using their hands for gestures and this effect depended on gesture type (beat vs. representational).

4.1. Valence and handedness

Studies on handedness and emotional valence show that people link positive ideas with their dominant-hand-side (Casasanto, 2009; Casasanto & Chrysikou, 2011; Fuente et al., 2014; de la Fuente et al., 2015). Moreover, in a conversation people hint these representations through their gestures, using their dominant hands while talking about positive topics and non-dominant hands during negative conversations (Casasanto & Jasmin, 2010). Since it takes two to communicate, we wanted to understand if the conversation partners were able to take these body specific hints.

Throughout our stimuli videos or the instances of both-hand gestures in each video, there was no difference in looking at the left or right side of the screen between handedness groups. Only for both-handed gestures, emotional valence of the stories affected participants' information collection. When the stories were positive, people preferred to look at the right side of the screen (the actor's left side) and when the stories were negative, the preference leaned towards the left (the actor's right side). There was no significant effect for handedness or people's ideas on the actor's hand preference. However, since the number of participants who thought the actor was left-handed was small compared to the rest of the participants who thought the actor was right-handed, these results may not be completely conclusive. Still there is some evidence indicating the pairing of "good" with right side of space and "bad" with the left side could be beyond practical handedness. One reason could be a byproduct of a right-handed society, in which 90% people are right-handed. Thus, individuals have more exposure to right-handed people and as a result even left-handed people may modify their pairing of good and bad with the right and left side of the space. Furthermore, since our study was conducted with Turkish participants, the effect of Turkish culture that supports the "good is right" way of thinking can have an influence on our findings.

In another aspect, our results could also be explained by *the valence hypothesis*, which suggests that the right hemisphere is specialized for negative emotions and the left hemisphere is specialized for positive emotions (Silberman & Weingartner, 1986). One of the studies confirming this hypothesis was by Rodway, Wright, and Hardie (2003). They reported increased accuracy for emotion recognition on the positive faces appearing on the right-hand side and negative faces on the left-hand side of the screen and no handedness difference among conditions for accuracy. This tendency of linking positive with right and negative with left regardless of handedness was also demonstrated in our study and hemispheric specialization could be a reason for this effect.

We also analyzed the side preference in looking to the left and right for the first seconds of the videos to see if the initial and more reflexive attempts of participants would change according to their hand preference. Our results revealed no difference between groups or an effect of emotional valence. This lack of difference could be explained due to minimal the affect manipulation during the first second of the video, because the only emotional manipulation was established by presenting the video title in the beginning of the videos.

We compared the first three seconds of the videos for looking preferences and there was a significant decrease in time spent looking to the left side of the screen for both positive and negative videos. Regardless of the hand preference, participants displayed an initial left side bias and moved their attention to the right side through the first three seconds. This directionality effect was also observed in other studies with other tasks such as producing side views of different objects (to see if the objects were facing left or right) (Karev, 1999; Kebbe, 2013; Dobel, 2015). These studies indicated no difference between left- and right-handed people in drawing orientation, presenting a strong tendency for left orientation in line with our results. Another study using eye tracker did find an effect of handedness on side-bias (Ossandon, Onat & König, 2014). They showed different images such as nature and urban themed photos and generated noise images as control to participants and coded their fixations for different time points in seconds. Their results indicated a strong initial left bias and a weaker right bias for the following seconds only for the right-handed people. The left-handed participants in their study displayed no bias for left or right while viewing the images. In the present study, the initial left and following right biases are present for both handedness groups.

Finally, for the mirror and original videos we found no effect of gaze information by handedness or valence, yet most of the participants in the mirror condition still thought that the gesturer was left-handed. An explanation for this finding could be the salience difference between gestures; our gestures were not the same for left and right hands. Some of these gestures might be more memorable for the participants causing a deduction for the gesturer’s handedness at the end of the session. Nevertheless, the lack of difference in gaze duration for sides for both-hand gestures shows that the real-life handedness of the gesturer had no effect on our results.

Overall, we did not find any evidence for the interaction of handedness and valence in any level of our analyses on gaze information. Our stimuli were complex compared to the previous stimuli used in body specificity studies such as the bob task or reaction-time tasks that focuses on one specific bias. In our study, we wanted to see if complex stimuli that have more resemblance to a real life situation can evoke the body specific biases as well. Our results demonstrate that along with different variables and other biases we employ in real life; our assumed body specific biases may fail to be effective.

4.2. Gesture production

After watching each video we asked participants to retell the stories and recoded their gestures to see if the emotional characteristics of the stories would affect the hand they preferred to use while spontaneously gesture.

In general there was no difference in frequency for both-hand and one-handed gestures produced by participants. Yet, when the beat and representational gestures were compared beat gestures were four times more frequent than the representational gestures

(Nrepresentational =117 vs. Nbeat= 470). The reason for recoding a larger number of beat gestures could be our cover story as a memory task. Since beat gestures and not iconic gestures were found to facilitate target word production (Lucero, Zaharchuk & Casasanto, 2014), the need to remember the words for the task could encourage beat gesture use.

There was no effect documented for emotional valence on the hand choice of gesture. Simply an effect of handedness was found: the left-handers used their left hand more than their right hand and the exact opposite pattern was observed for right-handers. Our results did not replicate the study by Casasanto & Jasmin (2010), in which they stated that politicians with different hand preferences used their dominant hand more during positive utterances and non-dominant hand more during negative speech. The reason for the difference may lie in the methods and population included. The present study was a controlled experiment with the emotional characteristics of speech accompanying gestures were manipulated whereas Casasanto and Jasmin's (2010) study examined previously recorded videotapes as case studies and had naturalistic data regarding emotional valence. We manipulated the emotional valence through regular, everyday stories with generally negative or positive connotations. These stories may have different meanings for some of our participants due to pre-experimental exposure. For example, if resolved with a positive outcome, one could have a positive memory of a car crash. The same conflict is also present for the politicians included in Casasanto and Jasmin (2010), even the ratings of positive and negative utterances were done by independent raters while politicians themselves may not agree on the emotional value of the utterances. Future research could include self-ratings on the emotional valence component.

Moreover, our participants listened to the stories knowing that they have to re-tell it as accurately as possible. This may distanced them from the emotional value of the stories. In a natural conversation setting, we do not only focus on the emotional content, as there are so many variables and many other biases to consider. Finally, our population included university students with a close profile to general lay person, while the politicians included in Casasanto and Jasmin's (2010) study, probably had speech and body language trainings and with a purpose of persuading people, which would lead more awareness and control over ones gestures.

Our gesture production results also indicate that as well as quantity, the quality of the gesture production was significantly different for handedness groups. For beat gestures, right- and left-handed participants preferred to use their dominant hand more, similar to the general gesture production results. However, when participants produced representational (static, dynamic and pointing) gestures, only right-handed participants preferred to use their dominant hand more. The left-handed participants did not choose to use one hand more compared to the other. The hand preferences for different types of gestures have been a topic of research and mixed findings were reported. Studies mostly included right-handed participants only and found a right-hand preference for representational gestures (Sousa-Poza, Rohrberg, & Mercure, 1979; Stephens, 1983; Blender et al., 1995; Foundas et al., 1995). For non-representational gesture use, the findings were diverse; while Sousa-Poza, Rohrberg, Mercure (1979) and Stephens (1983) reported no difference in hand preference in right-handers for non-representational type of gestures, Blonder and colleagues (1995) reported a left hand, Foundas and colleagues (1995) reported a right hand preference for right-handed individuals. One of the few studies that included left-handed participants reported that participants used their dominant hand for representational gestures and there were no differences in handedness for beat gestures (Stephens, 1983).

Gesture and speech are considered two closely linked mechanisms (McNeill, 1985). Our results for no hand preference in left-handed participants for representational gestures could be explained by the hemispheric symmetries present in left-handers for language lateralization. Various studies reported asymmetric left hemisphere lateralization for right-handed people and atypical-symmetric lateralization for left-handed people. Representational gestures particularly relate to language. Additionally, representational gestures activate language areas in the brain (Dick et al., 2009). The organization of language activation in hemispheres reflects itself in our representational gesture production as well. The right-handers who employed their left hemisphere for language production preferred to use their right hands more often than their left hands. In contrast, the left-handers who tended to have a symmetrical activation in two hemispheres did not prefer one hand to the other for representational gestures. Thus, our spontaneous gesture production findings during retelling add to the literature about the close relation between speech production and gesture use based on handedness.

CONCLUSION

Our study investigated handedness, emotional valence, and gesture comprehension associations in a novel format using eye gaze information to present a possible link among these variables. We found no effect of handedness for gesture comprehension of negative and positive scenarios, but a general effect of emotional valence was demonstrated for looking at different sides of the screen. We also presented a directionality (from left to right) effect for the first three seconds of looking at the videos without a handedness group effect. In addition, when we asked to retell the stories participants watched, there was a difference in the preference of using left vs. right hands based on handedness, but only for the representational gestures. Emotional valence did not influence the hand participants used for gestures.

Our findings shed light on to the literature on the body specificity hypothesis, adding evidence from gesture comprehension. Although the findings contradict to the previous literature on the body specificity hypothesis, this may be due to the task difference or experimental design.

Nevertheless, this lack of significant difference between handedness groups illustrates that the body specific mental representations may fail to spread out to the conversational level. Finally, little research on the handedness and emotional relationships has been conducted with children, especially left-handed children. To better understand the cultural effects or writing direction effects, future research may benefit studying children’s hand preferences and their attention to others’ gestures.

REFERENCES

Blonder, L. X., Burns, A. F., Bowers, D., Moore, R. W., & Heilman, K. M. (1995). Spontaneous gestures following right hemisphere infarct. *Neuropsychologia, 33*(2), 203-213.

Brunyé, T. T., Gardony, A., Mahoney, C. R., & Taylor, H. A. (2012). Body-specific representations of spatial location. *Cognition, 123(2),* 229-239.

Casasanto, D. (2009). Embodiment of abstract concepts: good and bad in right-and left-handers. *Journal of Experimental Psychology: General, 138(3),* 351.

Casasanto, D. (2014). Bodily Relativity. *Routledge Handbook of Embodied Cognition.* L. Shapiro (Ed.) pp. 108-117. New York: Routledge.

Casasanto, D., & Chrysikou, E. G. (2011). When left is "right" motor fluency shapes abstract concepts. *Psychological Science, 22(4),* 419-422.

Casasanto, D., & Jasmin, K. (2010). Good and bad in the hands of politicians: Spontaneous gestures during positive and negative speech. *PLoS One, 5(7),* e11805.

de la Fuente, J., Casasanto, D., & Santiago, J. (2015). Observed actions affect body-specific associations between space and valence. *Acta Psychologica,156,* 32-36.

de la Vega, I., De Filippis, M., Lachmair, M., Dudschig, C., & Kaup, B. (2012). Emotional valence and physical space: Limits of interaction. *Journal of experimental psychology: human perception and performance, 38(2),* 375.

de la Vega, I., Dudschig, C., De Filippis, M., Lachmair, M., & Kaup, B. (2013). Keep your hands crossed: The valence-by-left/right interaction is related to hand, not side, in an incongruent hand–response key assignment. *Acta Psychologica, 142(2),* 273-277.

Dick, A. S., Goldin-Meadow, S., Hasson, U., Skipper, J. I., & Small, S. L. (2009). Co-speech gestures influence neural activity in brain regions associated with processing semantic information. *Human Brain Mapping*, *30*(11), 3509-3526.

Dobel, C., Diesendruck, G., & Bölte, J. (2007). How writing system and Age influence spatial representations of actions a developmental, cross-linguistic study. *Psychological Science, 18*(6), 487-491.

Driskell, J. E., & Radtke, P. H. (2003). The effect of gesture on speech production and comprehension. *Human Factors: The Journal of the Human Factors and Ergonomics Society, 45(3),* 445-454.

Foundas, A. L., Macauley, B. L., Raymer, A. M., Maher, L. M., Heilman, K. M., & Rothi, L. J. G. (1995). Gesture laterality in aphasic and apraxic stroke patients. *Brain and Cognition*, *29*(2), 204-213.

Fuente, J., Casasanto, D., Román, A., & Santiago, J. (2014). Can Culture Influence Body-Specific Associations Between Space and Valence? *Cognitive Science, 39,* 821–832.

Holle, H., Obleser, J., Rueschemeyer, S. A., & Gunter, T. C. (2010). Integration of iconic gestures and speech in left superior temporal areas boosts speech comprehension under adverse listening conditions. *Neuroimage, 49(1),* 875-884.

Karev, G. B. (1999). Directionality in right, mixed and left handers. *Cortex,35(3),* 423-431.

Kebbe, H., & Vinter, A. (2013). How culture, age, and manual dominance affect directionality in drawing side view objects. *Journal of Cross-Cultural Psychology, 44(1),* 160-172.

Kelly, S. D., Barr, D. J., Church, R. B., & Lynch, K. (1999). Offering a hand to pragmatic understanding: The role of speech and gesture in comprehension and memory. *Journal of Memory and Language, 40(4),* 577-592.

Kelly, S. D., Kravitz, C., & Hopkins, M. (2004). Neural correlates of bimodal speech and gesture comprehension. *Brain and Language, 89(1),* 253-260.

Kelly, S. D., Özyürek, A., & Maris, E. (2009). Two Sides of the Same Coin Speech and Gesture Mutually Interact to Enhance Comprehension. *Psychological Science. 21*(2), 260-267.

Kominsky, J. F., & Casasanto, D. (2013). Specific to whose body? Perspective-taking and the spatial mapping of valence. *Frontiers in Psychology, 4.*

Kong, F. (2013). Space–valence associations depend on handedness: evidence from a bimanual output task. *Psychological research, 77(6),* 773-779.

Lucero, C., Zaharchuk, H., & Casasanto, D. (2014). Beat gestures facilitate speech production. In *Proceedings of the 36th Annual Meeting of the Cognitive Science Society (CogSci 2014)* (pp. 1694-1699).

McNeill, D. (1985). So you think gestures are nonverbal?. *Psychological Review, 92*(3), 350.

McNeill, D. (1992). *Hand and mind: What gestures reveal about thought.* University of Chicago Press. Chicago.

Oldfield,R.C.(1971).The assessment and analysis of handedness: the Edinburgh inventory. Neuropsychologia 9, 97–113.

Ossandón, J. P., Onat, S., & König, P. (2014). Spatial biases in viewing behavior. *Journal of vision, 14*(2), 20.

Riseborough, M. G. (1981). Physiographic gestures as decoding facilitators: Three experiments exploring a neglected facet of communication. *Journal of Nonverbal Behavior, 5(3),* 172-183.

Rodway, P., Wright, L., & Hardie, S. (2003). The valence-specific laterality effect in free viewing conditions: The influence of sex, handedness, and response bias. *Brain and Cognition, 53(3),* 452-463.

Silberman, E.K., Weingartner, H., 1986. Hemispheric lateralization of functions related to emotion. *Brain and Cognition, 5,* 322–353.

Sousa-Poza, J. F., Rohrberg, R., & Mercure, A. (1979). Effects of type of information (abstract-concrete) and field dependence on asymmetry of hand movements during speech. *Perceptual and Motor Skills, 48(3c),* 1323-1330.

Stephens, D. (1983). *Hemispheric language dominance and gesture hand preference* (Doctoral dissertation, University of Chicago, Department of Behavioral Sciences, Committee on Cognition and Communication).

Sueyoshi, A., & Hardison, D. M. (2005). The role of gestures and facial cues in second language listening comprehension. *Language Learning, 55(4),* 661-699.

Van Strien, J. W., & Van Beek, S. (2000). Ratings of emotion in laterally presented faces: Sex and handedness effects. *Brain and Cognition, 44(3),* 645-652.

Willems, R. M., Hagoort, P., & Casasanto, D. (2010). Body-specific representations of action verbs neural evidence from right-and left-handers. *Psychological Science, 21(1),* 67-74.

APPENDICES

APPENDIX A

Script Texts for Positive and Negative Stories

Bold: action gestures

Underlined: object gestures

Positive Scenarios:

Scenario 1: Piknik - Picnic

Ne zamandır hava çok güzel! Biz de dun ufaklıklarla(sol) pikniğe **gittik(sol).** Yerleştikten hemen sonra mangalı(iki el) **yaktık(sağ)**. Yemekten sonra biz **sohbet ederken(iki el),** çocuklar(sağ) da bütün gün etrafta(sol) **koşuşturdular(sol)**. Bir ara birlikte **ip atlayıp(sağ)** top(sağ) oynadık ama en beğendikleri aktivite uçurtma(iki el) **uçurmaktı(iki el).**

The weather has been very nice lately! So we ***went on (left)*** *a picnic with the little kids (left). After settling down, we* ***started the fire (right)*** *for the barbecue (both hands). After dinner as we* ***chat (both hands)****, kids (right)* ***ran (left)*** *around (left) all day. At some time, we* ***jumped rope (right)*** *and played ball (right) together, but their favorite activity was* ***flying (both hands)*** *the kite (both hands).*

Scenario 2: Doğum günü - Birthday

Bugün benim doğum günüm! Arkadaşlarımla pasta(sağ) **keserek(sağ)** kutladık. Mumları(iki el) **üfledikten(iki el)** sonra sürpriz hediyelerini(sol) **aldığımda(sol)** çok heyecanlandım. En büyük hediye kutusunu(iki el) **açtığımda(iki el)** ne gördüm dersiniz? Hep istediğim yavru köpek(sol) birden dışarı atlayıp **koşmaya(sol)** başladı. Uzun bir süre evin içinde(sağ) kahkahalarla onu **yakalamaya (sağ)** uğraştık.

Today is my birthday! We celebrated with friends by ***cutting (right)*** *a cake (right). After I* ***blew (both hands)*** *the candles (both hands), I got excited when I* ***got (left)*** *their surprise presents (left). When I* ***opened (both hands)*** *the biggest box (both hands), what did you think I saw? The puppy (left) I always wanted jumped right up and started* ***running (left)****. For a long time we* ***chased (right)*** *it around (right) the house with laughter.*

Scenario 3: Maç kazanma – Winning a game

Dün ilk voleybol maçımı kazandım! Maçtan önce o kadar heyecanlıydım ki formamı(sol) ters **giymişim(sol).** Ama oyun başladığında heyecanım kayboldu ve toplara(iki el) düşünmeden **koşmaya(iki el)** başladım. Oyunun sonunda skor tahtası(sağ) bizim kazandığımızı göstererek **yanıp söndü(sağ).** Ardından bütün seyircilerle(sol) toplanıp **sarılarak(sol)** zaferimizi kutladık. Çıkışta koçun aldığı pastayı(sağ) **kestik(sağ)**. Bütün gece, şişirdiğimiz balonlarla(iki el) biraz daha **voleybol oynayıp(iki el**) kutlama yaptık.

I won my first volleyball game! I was so excited before the game I ***wore (left)*** *my uniform (left) inside out. When the game started, my excitement went away and I* ***ran (both hands)*** *to the balls (both hands) without thinking. At the end of the game the score table (right)* ***flashed (right)*** *indicating our win. After that we celebrated our victory* ***hugging (left)*** *the audience (left). In the end we* ***cut (right)*** *the cake (right) our coach brought for us. And through the night we blew some balloons (both hands) and kept* ***playing (both hands)*** *some more volleyball with them.*

Bold: action gestures

<u>Underlined: object gestures</u>

Negative Scenarios:

Scenario 1: Araba kazası – Car accident

Bu günlerde çok şanssızım. Daha yeni **kar yağdığı(sağ)** için <u>yerler(sağ)</u> buz tuttu. Biz de dün <u>yolda(iki el)</u> **giderken(iki el)** kaza yaptık. <u>Kar lastiğini(sol)</u> henüz takmadığım için araba **kaydı(sol)**. <u>Trafik ışıklarına(sağ)</u> geldiğimizde önümüzdeki arabaya **çarptık(sağ)**. Arabanın kaportası tamamen **çöktü(sol)** <u>farlar(sol)</u> kırıldı. Keşke arabanın <u>hava yastığı(iki el)</u> **patlasaydı(iki el)**, bu kadar ciddi yaralanmazdık.

*I am so unlucky lately. Because it **snowed (right)** recently the <u>roads (right)</u> were icy. So we had a car crash while **driving (both hands)** on the <u>road (both hands)</u> yesterday. Because I didn't install the <u>snow tire (left)</u> yet the car **slid (left)**. At the <u>traffic lights (right)</u> we **crashed (right)** into the car in front of us. The hood of the card **dented in (left)** and our <u>headlights (left)</u> broke. I wish the <u>airbags (both hands)</u> had **deployed (both hands)** we wouldn't be as seriously wounded as we are.*

Scenario 2: Dersten kalma – Failing classes

Bu dönem iki dersten kaldım. Final sabahı <u>telefonun(sol)</u> **alarmını kapatıp(sol)** uyuyakalmışım. Telafi için hocayla konuştuğumda ise <u>ödev(sağ)</u> **yazabileceğimi(sağ)** söyledi. Ama maalesef ödevi yazmadan önce dışarıda <u>bisikletten(iki el)</u> **düştüm(iki el)**. Bileğim ve <u>dizim(sağ)</u> incindiği için **yürüyemiyordum(sağ).** İyileşene kadar <u>yatağımda(iki el)</u> **yatmak(iki el)** zorunda kaldım. Telafiye girebileceğimi söylediler fakat sadece <u>kitap(sol)</u> **okuyarak(sol)** çalışabildiğim için geçer not alamadım.

I failed two classes this semester. At the finals morning I ***put of the alarm (left)*** *of my* <u>*phone (left)*</u> *and overslept. When I talked to the professor for compensation she told me I could* ***write (right)*** *an* <u>*assignment (right)*</u>*. But, before finishing it I* ***fell (both hand)*** *from my* <u>*bike (both hands)*</u>*. My wrist and* <u>*knee (right)*</u> *was injured and I couldn't* ***walk (right)****. I had to* ***lie down (both hands)*** *on my* <u>*bed (both hands)*</u> *until I got better. I was told I could attend the make-up test however I could only study by* ***reading (left)*** *the* <u>*books (left)*</u>*, and so I couldn't get a passing score.*

Scenario 3: Tartışma - Quarrel

Sonunda ev arkadaşlarımla kavga ettim. Öncelikle <u>anahtarları(sağ)</u> olmasına rağmen sürekli **zile basıyorlar(sağ)**. Yemek yedikleri <u>tabakları(iki el)</u> mutfak masasına öylece **bırakıyorlar(iki el)**. Banyonun <u>musluğunu(sol)</u> hiçbir zaman tam olarak **kapatmadıkları(sol)** için <u>küvete(sağ)</u> boşu boşuna **su akıyor(sağ).** En sinir bozucu olanı da bunları **tartışmak(iki el)** istediğimde <u>kapıları(iki el)</u> sımsıkı kapatılmış oluyor. Ya da çok aceleleri olduğundan <u>çantalarını(sol)</u> kapıp **koşarak(sol)** evden çıkıyorlar.

Finally we had a quarrel with my home mates. First of all, although they have the <u>*keys (right)*</u>*, they still* ***ring (right)*** *the doorbell. They* ***leave (both hands)*** *the* <u>*plates (both hands)*</u> *on the table without cleaning. And since they never* ***turn off (left)*** *the* <u>*faucet (left)*</u>*, the water keeps* ***running (right)*** *down the* <u>*tub (right)*</u>*. The most annoying part is that whenever I try to* ***talk (both hands)*** *to them about these things they close the* <u>*doors (both hands)*</u> *tightly or they grab their* <u>*bags (left)*</u> *and* ***run out (left)*** *because of an emergency.*