THE EXPRESSIONS OF SPATIAL RELATIONS 
DURING INTERACTION IN AMERICAN SIGN 
LANGUAGE, CROATIAN SIGN LANGUAGE, 
AND TURKISH SIGN LANGUAGE 

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ABSTRACT

Signers use their body and the space in front of them iconically. Does iconicity lead to the same mapping strategies in construing space during interaction across sign languages? The present study addressed this question by conducting an experimental study on basic static and motion event descriptions during interaction (describer input and addressee re-signing/retelling) in American Sign Language, Croatian Sign Language, and Turkish Sign Language. I found that the three sign languages are similar in using classifier predicates of location, orientation, and movement, predominantly employing an egocentric (viewer) perspective but also a non-egocentric perspective, and using similar mapping strategies regardless of interlocutor positions. However, these three sign languages differ from each other in the effects of location and orientation of the objects in pictures and movies, the descriptions of picture (states) vs. movie (motion events), and describer input vs. addressee retellings in their mapping strategies. This study contributes to our knowledge of how the expressions of spatial relations are conveyed in natural human language.

KEYWORDS: Iconicity; sign language; spatial language and cognition.

1. Introduction

Using body and space to iconically represent spatial relations, sign languages provide new observations on the nature of spatial language and cognition. Previous research has indicated that sign languages can encode location, orientation, direction, and motion of entities in “classifiers”1 or verbs of location, ori-

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1 As one of the reviewers suggested, the definitions of basic terminology are given here. Sign lan-
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entation, and motion (e.g. Supalla 1986; Engberg-Pedersen 1993; Emmorey 2002; Schembri 2003). Additionally, sign languages appear to represent space more iconically than spoken languages do (e.g. Taub 2000, 2001; Emmorey and Herzig 2003; Wilcox 2004; Talmy 2006; Perniss 2007). Nonetheless, previous research has already shown that there can be language-specific structures even if signers encode space iconically (e.g., Perniss and Özyürek 2008; Özyürek and Perniss 2011; Özyürek et al. 2010; Arik 2010a, 2011). Aiming at contributing to this knowledge, the present study investigates how to encode spatial relations in three sign languages during interaction in American Sign Language (ASL), Croatian Sign Language (HZJ), and Turkish Sign Language (TID).

The motivation for studying possible effects of the presence of an addressee and the addressee’s positioning with respect to the describer during interaction come from the works in spoken languages. In spatial tasks, Schober (1993) showed that when an addressee is present, English speakers use more egocentric perspectives than when there is no addressee. This study also indicated that when the addressees take describers’ role, they take their partners’ perspectives. In another study, Schober (1995) argued that describers can take different perspectives when they share the addressees’ vantage point and when the addressees’ sit next to them or at 90 degrees. However, Shelton and McNamara’s study (2004) showed that English speakers prefer to take the addressees’ perspective regardless of their positioning.

The effect of the addressees’ position is also found in the descriptions of larger environments. Hund et al. (2008) studied whether the describers change their perspectives when giving directions to the addressees. They found that the describers use egocentric terms such as left-right and landmarks more frequently when the addressees driving in the town and use cardinal directions such as north-south more frequently when the addressees looking at a map. They argued that the describers take both the addressees’ perspectives into account and context when giving directions.

It appears that when using the expressions of space, speakers change their gestures depending on the location of the addressees. Özyürek (2000, 2002)
questioned whether speakers change their use of gestures depending on the addressees’ location. In one condition, a speaker and an addressee sat at a table where the angle between the speaker and the addressee was 120 degrees; whereas, in the other condition a speaker and two addressees sat at a table where the angle between the speaker and each one of the addressees was 120 degrees. Özyürek found that when the location of the addressee was kept constant, the change in the use of lexical items and gestures were less than when the location of the addressees are changed. Further analysis showed that speakers used more lateral gestures when there was one addressee seating at 120 degrees than two addressees seating at 120 degrees separately. Additionally, speakers used more diagonal gestures when the two addressees seating at 120 degrees separately than only one addressee seating at 120 degrees. In another study, Holler and Wilkin (2011) examined speakers’ use of gesture when there was an addressee in front of them and compared the speakers’ gestures to the gestures after the speakers received feedback from the addressee. They found that the speakers’ gestures accompanying speech were not changed even when the addressees asked for clarification and/or elaboration. Yet, as one expects, there was a decrease in the use of gestures when the addressees asked for confirmation. What is more relevant to the current study is that the speakers sometimes changed the use of gesture space (e.g. change in particular locations for some referents in the gesture space in front of them) and their viewpoint (e.g. using the lateral axis in the former description and the sagittal axis in their gesture space after the addressees’ feedback).

With respect to interaction and mental rotation, there is a related study conducted on a sign language, ASL, by Emmorey et al. (1998). In this study, ASL signers were asked to match a signed description of a room from either a describer perspective or an addressee perspective to a videotaped room. The participants preferred the describer perspective over the addressee perspective even though they required a 180 degree mental rotation of the signing space to process the descriptions from the describer perspective. The ASL signers and English speakers also watched a videotape in which there was a room with furniture and a clear entrance then, in order for them to match, they were shown an exact board in front of them or the same board rotated 180 degrees. They found that regardless of language, the participants preferred the exact board over the rotated board. However, when rotated, the ASL signers’ matchings were significantly better than those of the English speakers.

In the current study, I focus particularly on the following questions: Are the effects of the locations and orientations of the stationary and moving objects in the real space, the effects of the seating positions of the interlocutors during in-
teraction, and the effects of the addressee locations and their retellings on the spatial mappings the same across sign languages? In this paper, I will show that signers of different sign languages use (1) similar strategies due to iconic nature of signed spatial expressions and (2) different strategies due to language-specific mechanisms, perspective taking strategies, and dynamic nature of spatial constructions with regard to semi-experimental manipulations such as changes in positionings of referents and physical locations of interlocutors. Therefore, the findings provide new insights into our knowledge of how events are construed in languages from an experimental linguistic perspective.

2. Iconicity and space in sign languages

Iconicity is observed at all levels of grammar in sign languages studied so far (e.g. Pizzuto et al. 1995; Pizzuto and Volterra 2000; Pietrandrea 2002; Wilcox 2004; Janzen 2004, 2006). However, this does not necessarily mean that sign languages are pantomimic. Rather, iconicity in sign linguistics is generally defined as “a structure-preserving mapping between mental models of linguistic form and meaning” (Taub 2001: 23) and iconic relations are established between “construals of form and construals of reality” (Wilcox 2004: 141).

It appears that spatial relations are iconically mapped onto the hands and the signing space in front of the signers (e.g. Taub 2001; Sallandre and Cuxac 2002; Emmorey and Herzig 2003; Wilcox 2004; Talmy 2006; Perniss 2007). Sign languages use special linguistic forms, classifiers, to map the inherent features of the referents such as frontness as well as the relative locations, orientations, and motions of the referents in the signing space (e.g. Supalla 1986; Engberg-Pedersen 1993; Emmorey 2002). For example, in Figure 2, the ASL signer describes a picture in which a horse and a cow are on a sagittal axis and facing each other (Figure 1). In her description, the signer uses the lexical sign HORSE with her right hand then uses a classifier, CL1, to refer to the horse. She locates her right hand in the distal region of her signing space. She also uses the lexical sign COW with her left hand then uses the same CL1 classifier to refer to the cow. She locates her left hand in the proximal region of her signing space. Hence, these signs also show the relative locations of the two animals on the sagittal axis of her signing space. The ventral of the index fingers of each hand indicates the orientations of the animals; therefore, it is understood that the animals are facing each other. Because her hands are not moving, the description indicates that the two animals are stationary.
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Figure 1. A horse and a cow are on a sagittal axis and facing each other.

RH: HORSE \[\text{CL} \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_}\]  
LH: COW CL\text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_}\]  

‘The horse on the distal region and the cow on the proximal region are facing each other.’

Figure 2. Still frames, glosses, and translation of an ASL description of the picture in Figure 1.

Once signers map the referents such as figure and ground in a spatial relation to the signing space by using classifiers, they can modify the expressions. For example, suppose that the ASL signer in Figure 2 moves her right hand to her left hand and stops right before it while her left hand remains stationary. This expression indicates that the horse on the distal region walks to the cow on the proximal region. Suppose also that the signer in Figure 2 moves her hands simultaneously: The right hand from the distal region to the proximal region while the left hand from the proximal region to the distal region. This expression indicates that the horse and the cow walk toward each other then pass by.

\[\text{RH:}^2 \text{HORSE} \quad \text{CL} \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_}\]  
\[\text{LH:} \quad \text{COW} \quad \text{CL} \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_}\]  

\[\text{‘The horse on the distal region and the cow on the proximal region are facing each other.’}\]

\[\text{Figure 2. Still frames, glosses, and translation of an ASL description}\]
\[\text{of the picture in Figure 1.}\]

\[^2\text{Transcription conventions: RH = right hand, LH = left hand, SMALL CAPS = sign glosses, CL = classifier, __ = hold of a sign, static = stationary/not moving, move to ... = in motion.}\]
These iconic mappings, however, create various ways of expressing spatial relations in sign languages. For example, a set of classifiers that are used in referring to the inherent properties of the referents can vary across sign languages (Perniss et al. 2007). There could also be individual differences across signers. Therefore, for example, it is not expected for signers to use the classifier CL1 in referring to four-legged animals in all sign languages. Nor is it expected for the ventral of the index finger in the classifier CL1 to indicate the front of the referent in all sign languages, either. Additionally, signers can use several perspectives when they establish spatial relations. They can establish a spatial relation in the signing space from several viewpoints: (a) an observer perspective from their own viewpoint or (b) from their addressees’ viewpoint or (c) by taking a character perspective by which they describe the spatial relation from the referents’ viewpoint (e.g. Emmorey 2000; Janzen 2004; Perniss 2007). Thus, it is not expected to observe signers to use the same perspective regardless of their sign language.

Previous research has already shown that there can be crosslinguistic differences. Schembri et al. (2005) used the Verbs of Motion Production task from the Test Battery for American Sign Language (ASL) Morphology and Syntax to compare the productions of hearing participants, Australian Sign Language signers, and Taiwan Sign Language signers. They also compared their results with possible expressions in American Sign Language. They found differences in lexical items (e.g., handshape units); however, the way participants indicated motion and location appeared to be similar. In another study, Perniss and Özyürek (2008) investigated sign language narratives in Turkish Sign Language (TID) and German Sign Language (DGS) with a focus on classifier predicates and perspective taking. They found that these languages were similar in that signers of these languages used classifier predicates in their expressions of spatial events but they were different in perspective taking: TID signers used less character perspective than DGS signers. These findings suggest that there can be language-specific structures even in sign languages when it comes to the expressions of space (see also Özyürek et al. 2010).

In my own previous works (Arik 2010a, 2011), I have conducted a series of experimental studies to compare static and motion event descriptions in several sign languages. In one study, I have asked ASL, HZJ, and TID monolingual signers to describe pictures in which the locations and orientations of the objects were manipulated. In another study, I used a similar methodology in which ASL, HZJ, ÖGS (Austrian Sign Language), and TID monolingual signers were asked to describe motion events. The data analyses of the signed descriptions of the static and motion events, where the locations, orientations, and motion types
of the objects were manipulated, showed that these sign languages are similar to each other (1) in using classifiers of location and orientation in static situations; location, orientation, and movement in motion events; (2) in the amount of spatial information directly mapped from the real space to the linguistic signing space in static and motion events; and (3) in path-only and path+manner encodings of motion in motion events. The analysis also showed the following differences among these sign languages: (4) they do not use the same set of classifiers in static and motion events; (5) the spatial arrangements of the objects in the real space have different effects on the mapping strategies in static and motion events; and (6) the sign languages have different preferences for the encodings of path-only and path including manner in motion events.

3. Present study: Methodology

Because of the iconic properties of sign language grammars and my previous findings, I expect to find that, regardless of sign language, signers map axial, locational, orientational, and motional information onto their signing space. I hypothesize that sign languages differ from each other in their iconic mapping strategies for construing the spatial relations. I focus particularly on (a) the effects of the locations and orientations of the stationary and moving objects in the real space; (b) the effects of the seating positions of the interlocutors during interaction; and (c) to what extent the effects of the addressee locations and their retellings on the spatial mappings are the same across sign languages. In the current study, I adopted the same methodology of my previous works (Arik 2010a, 2011).

3.1. Participants

The participants of the present study were all Deaf who are active in their deaf communities and use sign language as a primary means of communication. A total of thirty-two adult deaf signers participated in this study: Ten ASL, eleven HZJ, and eleven TID signers (age > 18). The participants were deaf and born in deaf families, learned their sign language from deaf parents, attended the schools for deaf, and were active in their deaf communities in single-dialect areas. The ASL signers were from Indianapolis area, the US; the HZJ signers from Zagreb, Croatia; and, the TID signers from Izmir, Turkey.
3.2. Task

Pictures and movies with small toys (dolls, planes, trucks, and animals) in various spatial arrangements were used to elicit data. Shots were taken from about a 30-degree angle. In order to create movies, at least five shots were taken. In each frame, the position of the moving object changed. Then, the frames were put together in iMovie to create a motion picture, resulting in a movie about 1–2 seconds long.

There were four practice items, six pictures, six movies, and six fillers (see Appendix A and B for the testing items). The data from practice items and fillers were not analyzed. The order of the testing items and fillers was random. The participants saw the pictures and movies in a full-screen mode on an either 13″ or 15″ screen laptop. Each participant received the items in the same order. The within-subjects factors design was 2 × 3. The first factor was location with two levels: the objects were put either on a lateral (left–right) or sagittal (proximal–distal) axis. The second factor was orientation with three levels: the objects were facing either the same direction or each other or exactly opposite directions. The between-subjects factors were situation (pictures vs. movies), pair (describer input vs. addressee retelling), seating position (face-to-face vs. 90-degrees), and language (ASL vs. HZJ vs. TID). Note that if the descriptions were given from the describers’ perspective, the addressees would have required what amount to a 180 degree mental rotation in the face-to-face seating position and a 90 degree mental rotation in the 90 degree seating position.

3.3. Procedure

The same procedure was applied to the three language groups. The participants were assigned either a describer or an addressee role. The describer was asked to describe pictures and movies to the addressee who did not see the stimuli before or during the sessions. Then, the addressee retold the same description to the describer. There were two seating arrangements: They sat face-to-face and described the stimuli to each other (Figure 3); then, they sat at 90-degrees and described the same stimuli in the same order to each other (Figure 4). Notice that the addressee in Figure 3b applies a 180 mental rotation of the describers signing space in Figure 3a; whereas, the addressee in Figure 4b applies a 90 mental rotation of the describers signing space in Figure 4a.
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3.4. Coding and analysis

I coded the data according to the four measures: axis, location, orientation, and situation. For each measure, when the spatial information in the describers’ description matched that in the stimulus, it scored one; otherwise, zero. The maximum score was four. For example, in one of the pictures, there was a pig on the...
left and a goat on the right. Both were facing left and were stationary (picture). When signers indicated that the pig, the goat, their locations on the lateral axis of their signing space, their orientations, and the stationary situation, their descriptions scored the maximum score: four. If they indicated the pig and the goat on the lateral axis without specifying which one was on the left and on the right, their descriptions received zero for location but one for axis. The addressee retellings were also coded according to the same measures. But their descriptions were compared to the spatial information in the describers’ input, not the picture, because the addressees were not allowed to see the pictures.

Native signers of each language judged the descriptions and found that they were all grammatical and acceptable linguistic expressions. They also helped code the data. An independent rater coded 23% of all of the data to establish consistency among raters: An interrater reliability analysis showed that the ratings were consistent (r = .84).

I give examples below from the data to illustrate the coding system for the mappings of spatial axis and orientations. In Figure 5, two ASL signers sit at 90 degrees and describe a picture in which a horse and a cow are on a sagittal axis and facing each other (Figure 1) to each other. In Figure 6, two TID signers sit at 90 degrees and describe the same picture. In Figure 5a–b, the ASL signers use a classifier CL2 to indicate their locations and orientations. The fact that the fingertip[s] of the two hands, CL2, point to each other indicates that the two animals are facing each other. In Figure 6a–b, the TID signers indicate the locations and orientations of the horse and the cow, the TID describer uses a classifier CL2 while the TID addressee uses a classifier CL1. The fact that the fingertips of the two hands of the describer, CL2, and of the addressee, CL1, point each other indicates that the two animals are facing each other. Therefore, the describers and addressees directly map orientational information from the picture onto their signing spaces. Their descriptions receive a score of 1 for orientations. Note that these variations across signers within a single language suggest that there are multiple grammatical and acceptable ways to construe spatial relations in sign languages.

Now notice that the ASL describer in Figure 5a uses the sagittal axis of her signing space indicating that the horse and the cow on the sagittal axis in the picture; therefore, she takes the describer perspective which requires a 90 mental rotation of her signing space in her addressee’s production. However, even though her addressee is expected to use the sagittal axis of his signing space in his retelling, he uses his lateral axis (Figure 5b). Therefore, while the ASL describer receives a score of 1 for axis, the ASL addressee receives a score of 0 for axis. Furthermore, the TID describer in Figure 6a uses the lateral axis of his
signing space indicating that the horse and the cow on the lateral axis although the two animals are on the sagittal axis in the picture (Figure 1). Again, still, this description requires a 90 mental rotation of his signing space in his addressee’s production. His addressee in Figure 6b mentally rotates the description then uses the lateral axis of his signing space in his retelling. Therefore, the TID describer receives a score of 0 for axis. But the TID addressee receives a score of 1 for axis because he also uses the lateral axis as the TID describer does. Note that the addressees are not allowed to see the pictures.

Figure 5. Still frames of an ASL describer–addressee pair sitting at 90-degrees and describing a picture in which a horse and a cow are on a sagittal axis and facing each other (Figure 1).

Figure 6. Still frames of a TID describer–addressee pair sitting at 90-degrees and describing a picture in which a horse and a cow are on a sagittal axis and facing each other (Figure 1).
4. Results

I now turn the details of our analysis to show to what extent iconicity plays a role in signed descriptions in ASL, HZJ, and TID and whether these sign languages employ various iconic mapping strategies. As expected, all of the signers regardless of sign languages encode location and orientation in static situations, as well as movement in the case of motion events by means of the signing space and classifiers.

4.1. The effects of location and orientation

Repeated measures ANOVA was conducted to evaluate the effects of the location and orientation of the objects as the within-subjects effect on the overall scores including axis, location, orientation, and situation for each language separately. Table 1 gives the means and standard errors according to the factors and their levels with respect to languages. Table 2 gives $F$ and $p$ values. These scores indicate that the describers took the describer perspective in most of their descriptions which required either a 90 degree mental rotation or a 180 degree mental rotation in the addressee retellings depending on the seating situation of the addressees.

The analysis of the ASL scores revealed significant effects: the effect of location (lateral<sagittal) and the effect of orientation (facing opposite directions>same direction). There was also a significant interaction between the effects of location and orientation. The analysis of the HZJ scores showed a significant effect of location (lateral<sagittal), but there was no effect of orientation. However, there was an interaction between the effects of location and orientation.

The analysis of the TID scores indicated a significant effect of orientation due to the fact that facing each other ($M = 3.39$, $MSE = .07$) differed from both facing the same direction ($M = 3.12$, $MSE = .09$) and facing opposite directions ($M = 3.19$, $MSE = .09$). But there was no effect of location. However, there was an interaction between the effects of location and orientation.

These findings suggest that even though the interactions between location and orientation were found in the three language groups, the effects of location and orientation were not the same across the three sign languages. The ASL and HZJ descriptions (but not TID) mapped the axis, location, orientation, and situation information one-to-one onto their signing space more when the objects were on the sagittal axis than when the objects were on the lateral axis. Closer examination of the data showed that the ASL and HZJ signers can use the sagittal axis
Table 1. The means and standard errors according to the factors and their levels.

<table>
<thead>
<tr>
<th></th>
<th>Location</th>
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</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Lateral</td>
<td>Sagittal</td>
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<td>Same</td>
<td>Opposite</td>
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<tr>
<td></td>
<td>M</td>
<td>SE</td>
<td>M</td>
<td>SE</td>
<td>M</td>
<td>SE</td>
</tr>
<tr>
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<td>3.89</td>
<td>0.03</td>
<td>3.8</td>
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<td></td>
<td>3.79</td>
<td>0.04</td>
<td>3.88</td>
<td>0.02</td>
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<tr>
<td>HZJ</td>
<td>3.74</td>
<td>0.04</td>
<td>3.86</td>
<td>0.04</td>
<td>3.83</td>
<td>0.05</td>
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<tr>
<td></td>
<td>3.74</td>
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<td>3.83</td>
<td>0.05</td>
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</tr>
<tr>
<td>TID</td>
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<td>3.86</td>
<td>0.04</td>
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<td>0.09</td>
<td>3.19</td>
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Table 2. ANOVA results for possible main effects and interactions.

Significance is indicated by *.

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<thead>
<tr>
<th></th>
<th>F values</th>
<th>p values</th>
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<tr>
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<td>F(1, 52) = 8.00</td>
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<td></td>
<td>Orientation</td>
<td>F(2, 104) = 3.16</td>
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<tr>
<td></td>
<td>Location × Orientation</td>
<td>F(2, 104) = 5.15</td>
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<td>HZJ</td>
<td>Location</td>
<td>F(1, 64) = 6.96</td>
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<tr>
<td></td>
<td>Orientation</td>
<td>F(2, 128) = 2.57</td>
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<tr>
<td></td>
<td>Location × Orientation</td>
<td>F(2, 128) = 6.12</td>
</tr>
<tr>
<td>TID</td>
<td>Location</td>
<td>F(1, 48) = .34</td>
</tr>
<tr>
<td></td>
<td>Orientation</td>
<td>F(2, 96) = 3.95</td>
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<td></td>
<td>Location × Orientation</td>
<td>F(2, 96) = 24.22</td>
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</table>

of their signing space when referring to the objects on the lateral axis but not vice versa. Moreover, the ASL descriptions mapped the axes, location, orientation, and situation information one-to-one onto their signing space more when the objects were facing opposite directions than when the objects were facing the same direction. But the TID descriptions used one-to-one mapping strategies more when the objects faced each other than in the opposite directions or in the same directions. Finally, the manipulations in the orientations of the objects did not affect the HZJ mappings strategies.

4.2. The effects of situation, pair, seating arrangement, and language

Repeated measures ANOVA was conducted to evaluate the effects of situation (picture vs. movie), pair (describer vs. addressee), and seating arrangement
(face-to-face vs. 90-degrees), as the between-subjects effect on the overall scores including axis, location, orientation, and situation for each language separately. Table 3 below gives $F$ and $p$ values. The analysis of the ASL scores revealed that the effect of situation (picture $M = 3.89$, $MSE = .04$ vs. movie $M = 3.76$, $MSE = .04$) was significant. But there were no effects of pair and seating arrangement, and no interaction between the factors. The analysis of the HZJ scores revealed no effect of situation, pair, and seating arrangement, but an interaction between situation and pair. There was no other interaction between situation X seating, pair X seating, and situation X pair X seating. The analysis of the TID scores revealed that the effect of pair (describer $M = 2.97$, $MSE = .09$ vs. addressee $M = 3.50$, $MSE = .09$) was significant. No effect of situation or seating arrangement was found. The analysis also showed an interaction between situation and pair. There was no other interaction: situation X seating, pair X seating, and situation X pair X seating.

Table 3. ANOVA results for possible main effects and interactions. Significance is indicated by $^*$.  

<table>
<thead>
<tr>
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<th>F values</th>
<th>p values</th>
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<td>$p &gt; .05$</td>
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<td>$F(1, 64) = .40$</td>
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<tr>
<td>Situation X Pair</td>
<td>$F(1, 64) = 4.69$</td>
<td>$p &lt; .05^*$</td>
</tr>
<tr>
<td>Situation X Seating</td>
<td>$F(1, 64) = .33$</td>
<td>$p &gt; .05$</td>
</tr>
<tr>
<td>Pair X Seating</td>
<td>$F(1, 64) = .44$</td>
<td>$p &gt; .05$</td>
</tr>
<tr>
<td>Situation X Pair X Seating</td>
<td>$F(1, 64) = .44$</td>
<td>$p &gt; .05$</td>
</tr>
<tr>
<td><strong>TID</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Situation</td>
<td>$F(1, 48) = 1.78$</td>
<td>$p &gt; .05$</td>
</tr>
<tr>
<td>Pair</td>
<td>$F(1, 48) = 16.103$</td>
<td>$p &lt; .001^*$</td>
</tr>
<tr>
<td>Seating arrangement</td>
<td>$F(1, 48) = .03$</td>
<td>$p &gt; .05$</td>
</tr>
<tr>
<td>Situation X Pair</td>
<td>$F(1, 48) = 30.137$</td>
<td>$p &lt; .05^*$</td>
</tr>
<tr>
<td>Situation X Seating</td>
<td>$F(1, 48) = .95$</td>
<td>$p &gt; .05$</td>
</tr>
<tr>
<td>Pair X Seating</td>
<td>$F(1, 48) = .32$</td>
<td>$p &gt; .05$</td>
</tr>
<tr>
<td>Situation X Pair X Seating</td>
<td>$F(1, 48) = .02$</td>
<td>$p &gt; .05$</td>
</tr>
</tbody>
</table>
Repeated measures ANOVA was conducted to evaluate the effects of language (ASL vs. HZJ vs. TID) as the between-subjects effect on the overall scores including axis, location, orientation, and situation. The analysis showed a significant effect of language \( (F(2, 164) = 52.78, p < .001) \), indicating that the language a participant used in describing the stimuli made a significant difference in their scores. Post-hoc analysis using the Bonferroni method revealed that ASL \( (M = 3.82, \text{MSE} = .09) \) and HZJ \( (M = 3.80, \text{MSE} = .04) \) differ significantly from TID \( (M = 3.23, \text{MSE} = .04, p < .001) \).

These findings confirm that there is an overall difference in one-to-one mapping strategies in the three sign languages, indicating that regardless of the picture or movie descriptions, the describers’ input or addressees’ retellings, face-to-face interaction or seating at 90-degrees, the ASL and HZJ signers used more one-to-one mapping strategies than the TID signers did. Further differences were also found that, in ASL but not in HZJ or TID, the signers used more one-to-one mapping strategies for the pictures than for the movies. Interestingly, even though the TID describers did not directly map the spatial features onto their signing space, the TID addressees, who cannot see the original stimulus, relied on information in the describers’ descriptions and adopted the same perspective the describers used because there was no other information available. Additionally, the seating arrangements of the participants did not affect the mapping strategies across the three sign languages. This result shows that, with respect to the change in the addressee location, sign languages do not allow variations in the spatial mapping strategies.

5. Conclusion

In the present study, I reported a small-scale study conducted on basic static and motion event descriptions in pairs during interaction in the three unrelated sign languages: ASL, HZJ, and TID. Because of the iconic properties of sign language grammars (e.g. Pizzuto et al. 1995; Pizzuto and Volterra 2000; Pietrandrea 2002; Wilcox 2004; Janzen 2006) and findings from previous studies (e.g. Schembri et al. 2005; Perniss and Özyürek 2008; Özyürek and Perniss 2011; Özyürek et al. 2010; Arik 2010a, 2011), I expected to find that, regardless of sign language, signers map axial, locational, orientational, and motional information onto their signing space. The current study confirmed this expectation. The current study also provided additional evidence: Even when the addressees changed their positions with regard to the describer and retold/re-signed the describers’ description, the signers used classifiers and the signing space to encode
spatial properties of the events. Following previous works, I hypothesized that sign languages differ from each other in their iconic mapping strategies for construing the spatial relations. In the current study, I focused particularly on (a) the effects of the locations and orientations of the stationary and moving objects in the real space; (b) the effects of the seating positions of the interlocutors during interaction; and (c) to what extent the effects of the addressee locations and their retellings on the spatial mappings are the same across sign languages. The data analysis of the signed descriptions of the manipulations (location vs. orientation, picture vs. movie, describer vs. addressee, and seating face-to-face vs. at 90-degrees) revealed variations and patterns in ASL, HZJ, and TID.

The three sign languages are similar to each other in using complex predicates of location, orientation, and movement, in predominantly employing egocentric (viewer/narrator not addressee) and non-egocentric (neutral) perspectives, and in using similar mapping strategies regardless of interlocutor positions. Additionally, these three sign languages are different from each other in the effects of location, orientation, the descriptions of picture vs. movie, and describer inputs vs. addressee retellings in their mapping strategies. As expected, all of the ASL, HZJ, and TID signers encoded axis, location, orientation, and, where relevant, motion of the objects, by employing iconic predicates. Thus, the three sign languages are similar to each other in using complex predicates of location, orientation, and movement supporting the findings of Supalla (1986), Engberg-Pedersen (1993), Emmorey (2002), among others. The findings suggest that these sign languages constitute a uniform typological group in encoding path, manner, and predicate together because of the iconic mappings of the real word space onto the signing space. Supporting previous studies (e.g. Emmorey 1996; Janzen 2004; Perniss 2007), I also found that signers took a viewpoint in constructing spatial relations. However, only very few ASL descriptions included addressees’ perspective, similar to what Emmorey et al. (1998) found in their mental rotation tasks. This observation indicates that the describers as well as the addressees constructed the locational and motional information in the scenes egocentrically from their own perspective or non-egocentrically.

These findings can be comparable to the studies in spoken languages. Recent studies showed that when an addressee is present, English speakers can change their perspective taking strategies (e.g. Schober 1993, 1995; Shelton and McNamara 2004) and their use of gesture space depending on whether one or two addressees is present (Özyürek 2000, 2002) and depending on whether the addressees ask for further clarification (Holler and Wilkin 2011). The speakers can even change their perspectives in wayfinding depending on whether the ad-
Expressions of space during interaction 195
dressees are driving in the environment or looking at their maps (Hund et al. 2008). The findings from the current study suggests that in signed language descriptions, when an addressee is present, the signers do not change their perspectives contra to what English speakers can do. They describe the spatial arrangement of objects in static and motion events from their own perspective or non-egocentrically. In addition, while the English speakers can alter the use of gesture space with respect to the position of the addressee, the ASL, HZJ, and TID signers did not make significant changes in the use of signing space with respect to the position of the addressee (i.e., seating arrangements in the present study). This might be because sign languages use space both iconically and grammatically (see Sandler and Lillo-Martin 2005 for an overview and Liddell 2003 for an alternative view). As a first approximation, these findings suggest a clear difference between sign languages and spoken languages in the expressions of spatial relations during interaction. However, the studies on spoken languages reported above were conducted only on English, which may not be generalized to all spoken languages. After all, for example, the use of gestures in the spatial expressions can be quite diverse in spoken languages (see Kita 2009 for an overview). For example, some languages (e.g. English and Dutch) prefer to use egocentric terms such as left and right in their expressions of space whereas some others (e.g. Guugu Yimithirr) prefer to use cardinal directions. These preferences are also observed not only in non-linguistic tasks (e.g. Levinson and Wilkins 2006) but also in their gestural productions (e.g. Levinson 2003). Therefore, more studies are needed to explore the expressions of space in speech and co-speech gestures in spoken languages and in signing in sign languages during interaction before making further generalizations.

6. Acknowledgments

This study closely related to my recent publications (Arik 2009, 2010a, 2010b, 2011) is based in part on my dissertation project supported in part by NSF grant (BCS-0345314) awarded to Ronnie Wilbur, the Linguistics Program at Purdue University, the Lynn Fellowship, and the Bilsland Dissertation Fellowship given by Purdue Graduate School. I thank anonymous reviewers for their comments and the ASL, HZJ, and TID Deaf signers for their participation.
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APPENDIX A

The picture testing items and their descriptions. Location L = left, R = right, P = proximal, D = distal; Orientation Opp = Opposite directions, Same = Same direction, EA = Each other.

<table>
<thead>
<tr>
<th>Picture</th>
<th>Spec.</th>
<th>No. and description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Truck" /></td>
<td>L:Truck R:Truck Opp</td>
<td>1. Two trucks are on a lateral axis and facing opposite directions.</td>
</tr>
<tr>
<td><img src="image2" alt="Cow and Horse" /></td>
<td>P:Cow D:Horse EA</td>
<td>2. A horse and a cow are on a sagittal axis and facing each other.</td>
</tr>
<tr>
<td><img src="image3" alt="Pig and Ram" /></td>
<td>P:Pig D:Ram Opp</td>
<td>3. A ram and a pig are on a sagittal axis and facing opposite directions.</td>
</tr>
<tr>
<td><img src="image4" alt="Pig and Goat" /></td>
<td>L:Pig R:Goat Same</td>
<td>4. A pig and a goat are on a lateral axis and facing left.</td>
</tr>
</tbody>
</table>
APPENDIX B

Some of the still frames of the movie testing items and their descriptions. Location: L = left, R = right, P = proximal, D = distal; Orientation: Opp = Opposite directions, Same = Same direction, EA = Each other.

5. Two horses are on a lateral axis and facing each other.

6. A horse and a cow are on a sagittal axis and facing the same direction.

1. The cow on the left walks to the pig on the right, facing each other.

2. The man on the distal region walks to the woman on the proximal region, facing each other.
L: Man  R: Woman  Same
3. The woman on the right walks to the man on the left, stops right behind him.

P: Cow  D: Pig  Opp
4. The cow on the proximal region walks away from the pig on the distal region. They are back-to-back.

L: Cow  R: Pig  Opp
5. The cow on the left walks away from the pig on the right. They are back-to-back.

P: Woman  D: Man  Same
6. The woman on the proximal region walks to the woman on the distal region, stops right behind her.