Does Sign Language Shape Lateral Space-Valence Associations?

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Abstract

This study investigates whether linguistic influences can affect the manifestation of lateral space-valence mappings in people's minds. Although most oral languages and cultures of the world have expressions and conventions that associate the good with the right space, this association seems to be body-specific: while right-handers associate positive concepts with the right side and negative concepts with the left side, left-handers have the oppositive association, and the size of the effect of the body specificity does not vary with linguistic and cultural conventions. Thus, it is widely believed that this conceptual metaphor only depends on the body. However, sign languages do not seem to have any conventional association between lateral space and valence, and a recent study has shown that signers do not associate valence with lateral space, opening the possibility of a causal influence of language. The present study set to replicate this surprising and controversial finding by comparing a sign language group, consisting of Spanish and Chinese Sign Language users, and an oral Spanish control group on the widely applied "Bob" task in this field. Supporting prior findings, Spanish language participants associated the "good" with their dominant side of space, closely matching the anticipated proportion, but signers did not. This pattern of results can be explained by a strong linguistic influence on the formation of lateral associations of emotional valence, but we discuss some alternative possibilities.

Keywords: Body specificity hypothesis; Sign Language; Handedness; Emotional valence; Motor fluency; Conceptual metaphor

Introduction

Many languages and cultures associate good things with the right side of space and bad things with the left side of space. Linguistic expressions like "having two left feet" and "right-hand man" depict this pattern clearly (see, e.g., Foolen, 2019). Yet not everyone shows the associations suggested by the linguistic and cultural conventions. In conflict with them, left-handers tend to dissociate how they talk about space and valence and how they think about them, associating the good with the left side and the bad with the right side(Casasanto, 2009). The present study is closely modelled after Casasanto's (2009) experiment 1a. Participants are instructed to draw a good and a bad animal (zebra or panda, counterbalanced) in the boxes on the sides of a cartoon character on a paper diagram (see Figure 1) and to indicate their handedness afterwards. Results showed that 74% of the left-handers drew the good animal on the left of the cartoon character, and 67% of the right-handers drew the good animal in the right box. In a control task, boxes were arranged vertically. Both left-handers (89%) and right-handers (83%) drew the good animal in the top box (Casasanto, 2009). To explain this space-valence mapping, the body-specificity hypothesis (BSH) claims that the association between lateral space and valence is mediated by perceptuo-motor fluency: right- and left-handers associate positive valence more strongly with the side of space on which they experience greater motor fluency, their dominant side of space (Casasanto, 2009; Casasanto & Chrysikou, 2011; Phing et al., 2009). The BSH effect has been examined in various populations and diverse tasks, and it is now a well-established effect (e.g Brookshire & Casasanto, 2011; Brunyé et al., 2012; Castano et al., 2018; Kong, 2013; Zhao et al., 2016).

To assess whether the body-specific associations result from genetically determined neurological differences between right- and left-handers or from people's interactions with the physical environment, Casasanto and Chrysikou (2011) investigated people with changed lateral fluency. They showed that right-handers who had a unilateral stroke to their dominant side of space and were therefore forced to use their non-dominant hand showed reversed right-space valence associations, which can be determined as results of neurological differences. As brain lesions may induce long-term reorganization of the brain. In the second study they tested healthy right-handed participants, randomly assigned to wear a ski glove either on their right or left hand. With one hand wearing a glove during the training phase they placed dominoes vertically in synchrony with both their hands on the dots presented in front of them on a table. Those wearing the ski glove on their right hand thus experienced a short-term reversal of lateral motor fluency. After the training phase participants

removed the glove and were asked to perform the lateral space-valence mapping task described above.

Results showed that 63% of the participants who wore the ski glove on their dominant right hand placed the positively associated animal in the left box, in stark contrast to the standard choices of right-handers and to the people who wore the glove on their left hand. This finding underlines the causal role of motor experience in shaping abstract thought about emotional valence. De la Fuente et al. (2015) replicated this experiment with 96 participants either assigned to be the actor who performed the training or the observer standing behind the actor, sharing the same spatial perspective. Both associated the "good" animal with the side of the actor's more fluent hand, clearly validating that both perceptual and motor fluency have a strong influence on space-valence mappings (see also Brouillet et al., 2015; Casasanto & Henetz, 2012; Milhau et al., 2013; Song et al., 2019).

The prior pattern of results not only supported that perceptuo-motor fluency caused lateral associations of emotional valence, but they also suggested that linguistic expressions and cultural conventions did not have any effect on them. If they did, the influence of language and culture should add to the effect of motor fluency in right-handers and subtract from it in left-handers. In contrast, prior results showed that the effect of motor fluency in left-handers is either equal to or stronger than in right-handers. De la Fuente, Casasanto, Román, and Santiago (2015) examined this question in a culture with very strong conventions against the left and in favor of the right: Morocco. Contrary to any influence of culture, the good-is-right association was just as strong in right-handed Moroccans as in Spaniards and other Western samples. Further challenging cultural and linguistic influences on space-valence mappings, Li and Cao (2019) compared lateral space and valence mappings in Tibetan practitioners of Bön, a cultural and religious tradition that strongly favors the left over the right. If that culture shapes and influences the space-valence associations, a Bön participant should associate the good with the left side of space. Again, contrary to this hypothesis, right-handed Bön participants associated the good with the right side, demonstrating that space-valence mappings in people's minds are shaped by their bodily experience and not by cultural and linguistic conventions.

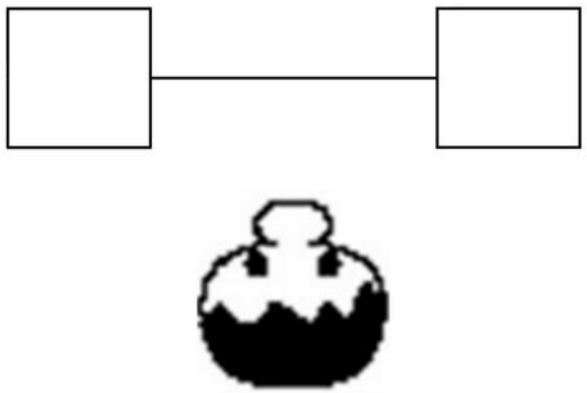

Fig. 1: The diagram sheet presented to participants (adapted from Casasanto, 2009).

Summing up, the previous literature on the conceptual metaphor that links positive and negative emotional valences with lateral space supports a single experiential cause: asymmetric perceptuo-motor fluency towards left and right. In this context, the study by Mansoory and Nassiri (2022) came as a strong surprise. These authors noticed that sign languages do not seem to have expressions that link positive valence with right space nor negative with left (Sutton-Spence & Kaneko, 2007; Sutton-Spence, 2010). Thus, comparing right-handed individuals of either Persian language or Persian Sign language presented a unique opportunity to investigate the influence of language on spatial-valence associations, as both groups share a cultural environment and bodily experiences. Spoken Persian language shows associations between horizontal axis and valence, linking space with the metaphorical reference to positive or negative concepts, like "having two left feet". These space-valence associations are not present in Persian Sign Language. In Persian Sign Language signs presenting right and left are exclusively used to point out right and left directions in space without any metaphorical reference. If language plays a role in establishing associations of lateral space and valence, users of Persian Sign Language should not show the body specificity effect, whereas speakers of Persian should.

The study consisted of a computer-based task, asking the participants to place a sad and a happy emoticon into two boxes, one on the left and one of the right, following a similar procedure to Casasanto's experiment 1a (2009). Right-handed Persian speakers showed strong associations between right and good, and left and badcongruent with their bodily experience, as expected from prior literature: 73.5% of them placed the happy emoticon into the right box. In contrast, Persian signers did not show a lateral space-valence association that could be statistically detected, despite the study having high statistical power (sample size was over 200 participants per group): only 55.2% of them placed the happy emoticon in the right box. In a control task with two new groups of participants the boxes were placed along the vertical axis (in the upper and lower space of the screen). Both spoken and signed Persian languages display the same association of positive valence with upper space and negative valence with lower space. Correspondingly, both the speakers and the signers showed the same tendency to place good on top and bad below in the emoticon task. The authors interpreted their findings as suggesting that language plays a causal role in shaping lateral space-valence associations.

The present research seeks to build upon Mansoory and Nassiri (2022) study, carrying out a conceptual replication aimed to validate the robustness of the pioneering initial findings, as well as their generalizability to other sign languages and cultures. The hypothesis posits that the

hearers will demonstrate the body specificity effect, whereas the sign language group will not exhibit such an effect, i. e., they will not associate the dominant side of space with the good. The study aimed to reproduce the Mansoory and Naassiri's (2022) findings using the standard version of the Bob task (Casasanto, 2009; see Figure 1), which has been used in most of the studies in this field. The spoken language participants were Spanish, and the signer participant group was composed of both users of Spanish Sign Language and Chinese Sign Language. As the prediction is the same for both sign languages, they will be treated as a single group, thereby achieving a larger sample size. Importantly, both Spanish and Chinese hearers have been shown to manifest the body-specific association between valence and space (e.g., Kong, 2013; de la Fuente et al., 2015).

Methods

Participants

A total of 179 people participated in the lab experiment. All of them signed informed and consent forms. The group of Deaf participants consisted of 85 individuals (43 female), of which 64 participants were Chinese, users of 中国手语 (zhongguo shouyu), the Chinese Sign Language, and 21 participants were Spaniards, users of the Spanish Sign Language. Data collection was completed before performing any analysis.. All Deaf participants were prelinguistically deaf and used sign language as their preferred mode of communication. The Spanish Deaf were 51.4 years old on average. The age of the Chinese Deaf participants was not collected. The hearing control group consisted of 94 speakers of Spanish (64 female, M_age = 21.3 years). One participant of the Deaf group and 8 participants of the hearing control group were excluded due to being classified as ambidextrous by the short version of the Edinburg Handedness Inventory (EHI; Veale, 2014). There was one left-hander in the Deaf group and four in the hearing group, who were included in the analysis. Sample size was not preestablished. Data from as many Deaf people as possible were collected and it was planned to recruit a control group of the same size, but a few more hearers were collected due to participant availability. Data of 84 Deaf participants and 86 hearing participants were analyzed. A power analysis carried out after data collection suggested that N=84 is the minimum sample size that allows to detect the smallest body specificity effect size reported in the prior literature using the Bob task with 80% power.

Materials

To evaluate the lateral space-valence conceptual mappings, the task developed by Casasanto (2009; Experiment 1a), referred here to as the "Bob task", was used. The participants were presented with an illustrative sheet with a cartoon character, seen from above, presented with a box on the left and one box on the right side (see Fig. 1). This diagram and task have a long trajectory in the field, in spite of consisting of only a single binomial trial (de la Fuente et al., 2014; de la Fuente et al., 2015; Li & Cao, 2019)

Procedure

The task instructions were presented in Spanish or signed to the participant by sign language experts in either Chinese Sign Language or Spanish Sign Language. They were told that the character, named Bob, was planning a trip to the zoo and that he loves zebras and thinks they are good but hates pandas and thinks they are bad. Both the order of presentation of the zebra and the panda as well as the valence association of the animal were counterbalanced over participants, so that there were four versions of the test. This rules out concerns about effects of order of mention and putative previous valence associations of the animal. Participants were instructed to place the animals in different boxes. The responses were given orally by the hearing group and signed or pointed by the Deaf participants.

After completing the task, the participants were asked to answer some filler questions mixed with the question "Why did you place the good animal in the box you chose?", to see how many participants suspected a relation between handedness and their choice of location of the good and bad animal**.** Of the Deaf participants, seven reasoned that handedness influenced their placement of the animals. In the hearing group, 25 participants indicated handedness as the reason of their placement as well. Finally, the participants' handedness was assessed using the short form of the Edinburgh Handedness Inventory (EHI; Veale, 2014), in which the participant is presented with four daily actions (e.g. "to write") and must indicate with which hand s/he would perform the action.

Research Design and Analysis

This study used a between groups design. As a low number of left-handers in the sample was expected, and in order to be able to use the data from as many participants as possible, the dependent variable was defined as the choice of placing the "good" animal in the box of the dominant side of space of the participant, that is, right-handers placing the "good" animal in the right box and left-handers placing the "good" animal in the left box. The independent variable was the language of the participants, either sign language (Spanish and Chinese Sign language) or oral Spanish. Three main analyses were performed. First, the proportion of association between the good animal and the dominant side of space for each group was calculated. The resulting proportions were then compared with the chance level (0.5) using a one-sided binominal test. Second, the we used a logistic regression to assess whether language group predicts the individual choices. Additionally, all tests were again performed for each group excluding the participants who indicated at debriefing that their handedness had influenced their response.

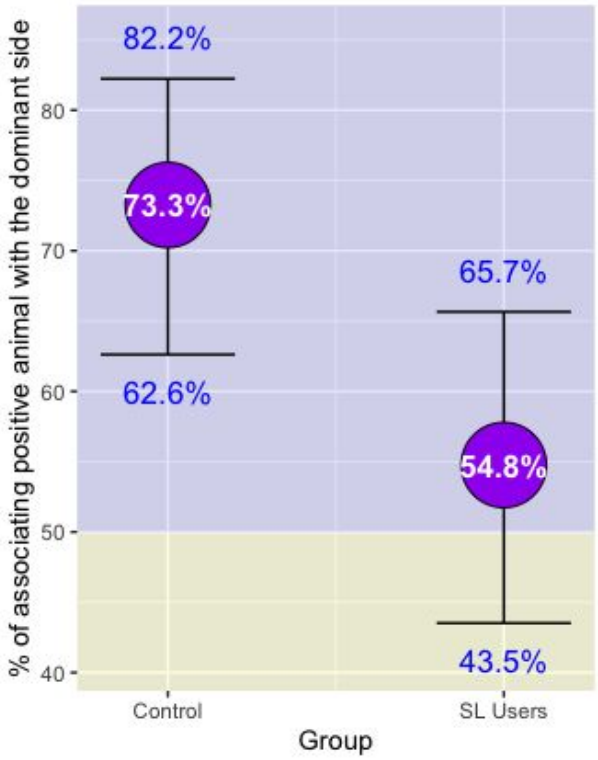

Fig. 2: Percentage of sign language and control hearers associating the good animal with the dominant side of space, plus 95% confidence interval.

Results

Results are depicted in Figure 2: 54.8% (95% *CI*: [43.5 - 65.7]) of the Deaf participants placed the good animal in the box of their dominant space. This proportion does not depart significantly from the 50% chance level *(p = 0.22)*. On the other hand, in the hearing control group 73.3% (95% *CI:* [62.6 – 82.2]) of participants placed the good animal in the dominant side of space, which was significantly different from chance *(p <0.001)*.

The strength of the body-specific bias in the Deaf and the hearing control groups was significantly different in a logistic regression test (*OR* = 2.26, p = 0.01*)*: the hearing control group was 2.26 times more likely to place the good animal in the dominant side of space than the Deaf group. Carrying out the same analyses for both groups excluding the participants who indicated handedness as a reason for their placement provided similar results: 64.5% of the hearing controls placed the good animal on the dominant side *(p = 0.015)* whereas only 53.2% of Deaf participants did *(p = 0.32)*. Yet, the difference in the strength of the associations between the groups was no longer significant *(p = 0.18)*, probably due to the loss of power.

Discussion

This study investigated the tendency to associate positive emotional valence with the dominant side of space, and negative valence with the non-dominant side, in a group of sign language users (both Spanish and Chinese) and a Spanish hearing control group. Present results clearly replicate the findings of Mansoory and Nassiri (2022). Hearing participants showed the body-specific associations that have been found in multiple samples previously. The proportion of good-is-right responses was nearly identical to the proportion observed by Mansoory and Nassiri (2022). For the right-handed participants (which are the majority of the sample) this outcome is consistent both with their bodily experiences and with their cultural and linguistic conventions. According to the body specificity hypothesis, the easier and more fluent interaction with the environment in their dominant side leads them to associate positive concepts with that side and negative ones with the opposite side (Casasanto, 2009). In contrast, the sign language participants did not associate the good with their dominant side of space strongly enough to be captured statistically. This is even more surprising because the dominant hand is the main articulating hand in sign language: most signs are either one-handed (performed with the dominant hand) or unbalanced bimanual (in which the dominant hand is the main signing hand and the non-dominant hand provides support or help). Purely bimanual signs are less frequent in lexical signs. Thus, signers have an even greater motor experience of fluency with their dominant hand than hearers, which should lead to an even stronger association of valence and space along the lines of motor fluency. In contrast, sign language users presented a much smaller body-specific association, small enough to miss statistical significance.

Why do users of sign language not show the body-specificity effect? One possibility is the interpretation suggested by Mansoory and Nassiri (2022): as sign language does not manifest the association between emotional valence and lateral space, these associations are prevented to form in the mind of signers. Sutton-Spencer (2016) explicitly stated, after investigating sign language poetry, that the metaphor of "good on the right" is not prevalent in sign languages due to the bilateral symmetry of the body and the handedness of the signers. Thus, left-right distinctions are metaphorically unproductive to communicate emotional valence in sign language. The absence of left-right metaphors for valence seems to be a general characteristic of signed languages. Mansoory and Nassiri's Persian Sign Language users, in contrast to the sign language group in this study, did not have a command of the local oral language (neither spoken nor written; Mansoory, personal communication). The present data show that the null effect in Deaf people remains even in participants that are more acquainted with oral local language. As Mansoory and Nassiri (2022) argue, the lack of these metaphors in sign language has such an important effect that is able to cancel out the information of body-specific associations (in spite of the extended use of the hands with asymmetric fluency in daily communication) and of good-is-right metaphors from exposure to cultural conventions (Iranian culture, as other Islamic cultures, has

strong cultural conventions that link the right hand with the good and the left hand with the bad). In other words, "sign language users prefer their language patterns over their bodily experience" (Mansoory & Nassiri, 2022, p. 6). This contrasts strongly with previous findings, such as the fact that followers of Bön associate good with the left linguistically and culturally, but still show body-specific associations (Li & Cao, 2019), and that the strength of the associations does not vary with the strength of relevant cultural conventions (De la Fuente et al., 2015). A way to test this account would be to teach new linguistic expressions in sign language to Deaf people, expressions that manifest an association between good and right (and left and bad). If the presence of those associations in language is the key factor that allows their development and manifestation in the Bob task, Deaf signers should now show the linguistic good-is-right association.

However, there may be alternative interpretations. One first possibility is that, against the apparent greater experience of fluency with the dominant hand that signers should have (as argued above), in sign discourse the non-dominant hand is used much more frequently than expected (Siyavoshi, 2017). Signers sometimes switch dominance and sign with their nondominant hand when the dominant hand is occupied. Hence, the flexible use of the non-dominant hand may contribute to the absence of lateral space-valence metaphors in signed language.

Another potential explanation for the absence of space-valence associations is perceptual instead of motor. Most signers are right-handed and thus, they see signing often on their left side. De la Fuente et al. (2015) showed that observing fluent movements on the left side makes the observer reverse their space-valence associations, that is, observed fluency affects the ipsilateral, not the contralateral side.

A final possibility suggests that the absence of the effect may be due to motor interference during the Bob task. Under this account, space-valence associations are formed in the mind of sign language users in the same way as in the minds of hearers, resulting only from the experiences of differential fluency to right and left sides, with neither language nor culture having any effect. However, these associations are not manifested in the Bob task because the use of sign language during the presentation of the task instructions, stimuli, and response, interferes with it. There are some hints in the literature towards effects of motor interference in this task: Song et al. (2019) showed that binding the hands in the back of observers impeded them to acquire new space-valence associations by watching performers of the ski glove task. A way to test this possibility is to investigate the effects of motor interference on the Bob task for hearing participants using an oral language. Motor interference by itself should be able to block the manifestation of the good-is-dominant-side association in this specific task. A second possibility would be to run the present study using bimodal bilinguals. The hypothesis of motor interference would be supported if bilingual hearing signers show the effect when the task is presented in the oral language and not when it is presented in sign.

To conclude, the present findings open a research venue that promises to advance the understanding of how language influences the mapping between lateral space and emotional valence, and therefore, the relationship between language and cognition.

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