Observed motor actions affect valence judgments

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Abstract

Right-handers tend to associate "good" with the right side of space and "bad" with the left. This implicit association appears to arise from the way people perform actions, more or less fluently, with their right and left hands. Here we tested whether observing manual actions performed with greater or lesser fluency can affect observers' space-valence associations. In two experiments, we assigned one participant (the actor) to perform a bimanual fine motor task while another participant (the observer) watched. Actors were assigned to wear a ski glove on either the right or left hand, which made performing the actions on this side of space disfluent. In Experiment 1, observers stood behind the actors, sharing their spatial perspective. After motor training, both actors and observers tended to associate "good" with the side of the actors' free hand and "bad" with the side of the gloved hand. To determine whether observers' space-valence associations were computed from their own perspectives or the actors', in Experiment 2 we asked the observer to stand face-to-face with the actor, reversing their spatial perspectives. After motor training, both actors and observers associated "good" with the side of space where disfluent actions had occurred from their own egocentric spatial perspectives; if "good" was associated with the actor's right-hand side it was likely to be associated with the observer's left-hand side. Results show that vicarious experiences of motor fluency can shape valence judgments, and that observers spontaneously encode the locations of fluent and disfluent actions in egocentric spatial coordinates.

Keywords: Handedness; emotional valence; space; perspective; observational learning; embodiment.

Introduction

Across many languages and cultures, the right is associated with positive and the left with negative evaluation (Hertz, 1917). In Spanish, the word "diestro" meaning "right-handed" also means "able," whereas the word "zurdo" meaning "left-handed" derives from the word "zocato" meaning "ugly" and "clumsy". English speakers use positive and negative idioms like "my right hand man" and "two left feet," and similar expressions have been reported in English, Italian, Arabic, and Chinese (McManus, 2002).

Yet, despite widespread linguistic and cultural conventions linking "good" with "right," left-handers implicitly associate "good" with "left" (Casasanto, 2009; 2011). Casasanto (2009) proposed that this implicit association arises from patterns of manual motor fluency: People tend to associate "good" with the side of space on which they can perform actions more fluently, typically with their dominant hand. To test this proposal, Casasanto & Chrysikou (2011) tested whether changing someone's patterns of manual motor fluency could change their associations between space and valence (i.e., positivity and negativity), accordingly. They assigned right-handers to perform a bimanual fine motor task while wearing a cumbersome ski glove on one of their hands. After this motor training task, participants who had worn the glove on their left hand, preserving their natural right-handedness, associated "good" with "right." By contrast, participants who had worn the glove on their right hand associated "good" with "left," like natural left-handers. This study validated the proposal that space-valence associations depend on asymmetries in manual motor fluency, and also showed that these associations can be rapidly changed by new patterns of motor experience.

Is motor experience the only way to influence people's space-valence associations? Since the advent of Social Learning Theory (Bandura, 1977), it has been clear that people learn not only directly through acting on the environment themselves, but also vicariously by watching others act (i.e., observational learning). The goal of the present study was to determine whether associations between space and valence depend exclusively on one's own hands-on experience, or whether they can also be influenced by seeing someone else acting more or less fluently with their right and left hands. In Experiment 1 we tested whether space-valence associations could be changed through vicarious motor experience. In Experiment 2 we changed the viewer's position relative to the actor to determine the perspective from which observational learning of space-valence associations occurred.

Experiment 1: Observational learning of space-valence associations

Method

Participants Students from the Arts Department of the University of Granada (N = 96; 48 female; average age: 24.7 years; range 18-39 years) volunteered to participate after providing informed written consent. All participants were right-handed. Their average score on the Edinburg Handedness Inventory (EHI; Oldfield, 1971) was 0.89.

Materials and Procedure Participants were tested in pairs and performed a two-part motor training experiment. Each participant was randomly assigned to either the role of "actor" or "observer." Actors and observers received instructions individually in separate rooms. Observers were told that the aim of the experiment was to test if the presence of a close observer affected negatively the actor's performance on a psychomotor task. Actors were told that their progress would be closely monitored and evaluated by the person observing them.

Training phase Actors performed the task used in Casasanto and Chrisykou (2011) Experiment 2. In what was ostensibly a test of psychomotor speed, participants arranged dominos upright on a 120 cm X 60 cm surface, on 80 equally spaced spots, as quickly as possible for 12 minutes. The 80 spots were separated by 12 cm. To induce an asymmetry in manual motor fluency, we assigned participants to wear a bulky ski glove on one hand, with the other glove dangling from the same wrist. Manipulating the dominoes was thus much more difficult with the gloved hand than with the free hand. The actor completed the task while sitting at a table. The observer stood behind the actor, facing the same direction (see fig. 1, left).

Test phase. After completing the dominoes task and removing the glove, participants returned to their separate rooms, where each completed a Spanish version of the "Bob goes to the zoo" task adapted from Casasanto (2009, Experiment 3). The observer completed the task before the actor.

Participants were presented with a diagram, in the center of which was the head of a cartoon character named Juan, seen from above, with one empty box on his left and another on his right. Participants were told that Bob was planning a trip to the zoo and that he loved pandas and thought they were good, but he hated zebras and thought they were bad (or vice versa, as animal-to-valence assignment was counterbalanced). Participants were asked to place the good animal in the box corresponding to good things, and the bad animal in the box corresponding to bad things (question order was also counterbalanced, to avoid confounding space and valence with numerical or temporal order). Responses were given orally and without visual support from the diagram sheet, which was removed from view before they responded in order to prevent manual responses (e.g., pointing). After completing this task, participants answered the following six debriefing questions (three filler questions and two relevant questions: (1) Are you studying English or French? (2) If you had to choose, would you say that today it will be rainy or sunny? (3) Why do you think you placed the good animal in the box that you did? (4) If you had to choose between keeping animals in the zoo or letting them stay free, what would you choose? (5) Do you think that the side of your dominant hand might have influenced your decision to place the good animal in the box that you chose? (6) What do you think this experiment was trying to evaluate? None of the participants suspected that the dominoes task was predicted to influence their performance on the diagram task, or that the experiment was designed to evaluate the influence of the actor on the observer. After the debriefing questions, participants completed the EHI (Oldfield, 1971) to assess their handedness.

Results and Discussion

Actors 92% of actors who wore the glove on their left hand (preserving their natural right-handedness) placed the good animal on the right (*Sign Test*, 22 vs. 2, p=0.00003). By contrast, 83% actors who wore the glove on their right hand (reversing their usual asymmetry in manual motor fluency) placed the good animal on the left, like natural left-handers (*Sign Test*, 20 vs. 4, p=0.001). The difference between the preferences of the right- and left-ski glove groups was highly significant (*Wald*=9.64, df=1, p=0.002). This finding replicates Casasanto & Chrysikou's (2011): a brief experience of a reversed motor fluency changed a clear good=right bias into an equally clear good=left bias.

Observers The observers' responses were very similar to the actors'. 87% of observers who watched an actor wearing the glove on the left hand placed the good animal on the right (*Sign Test*, 21 vs. 3, p=0.0002). By contrast, 79% of observers who watched an actor wearing the glove on their right hand placed the good animal on the left (*Sign Test*, 19 vs. 5, p=0.007). The difference between the preferences of the two groups of observers was highly significant (*Wald*= 8.82, df=1, p=0.003).

Comparisons of actors and observers The strength of the good-is-right bias did not differ between the group of actors that wore the glove on their left hand and the group of observers who watched them (*Wald*=0.20, df=1, p=0.66) by Fisher's Exact test; likewise, the strength of the good-is-left bias did not differ between between the group of actors that wore the glove on their right hand and the group of observers who watched them (*Wald*=0.26, df=1, p=0.87) by Fisher's Exact test. We also compared the

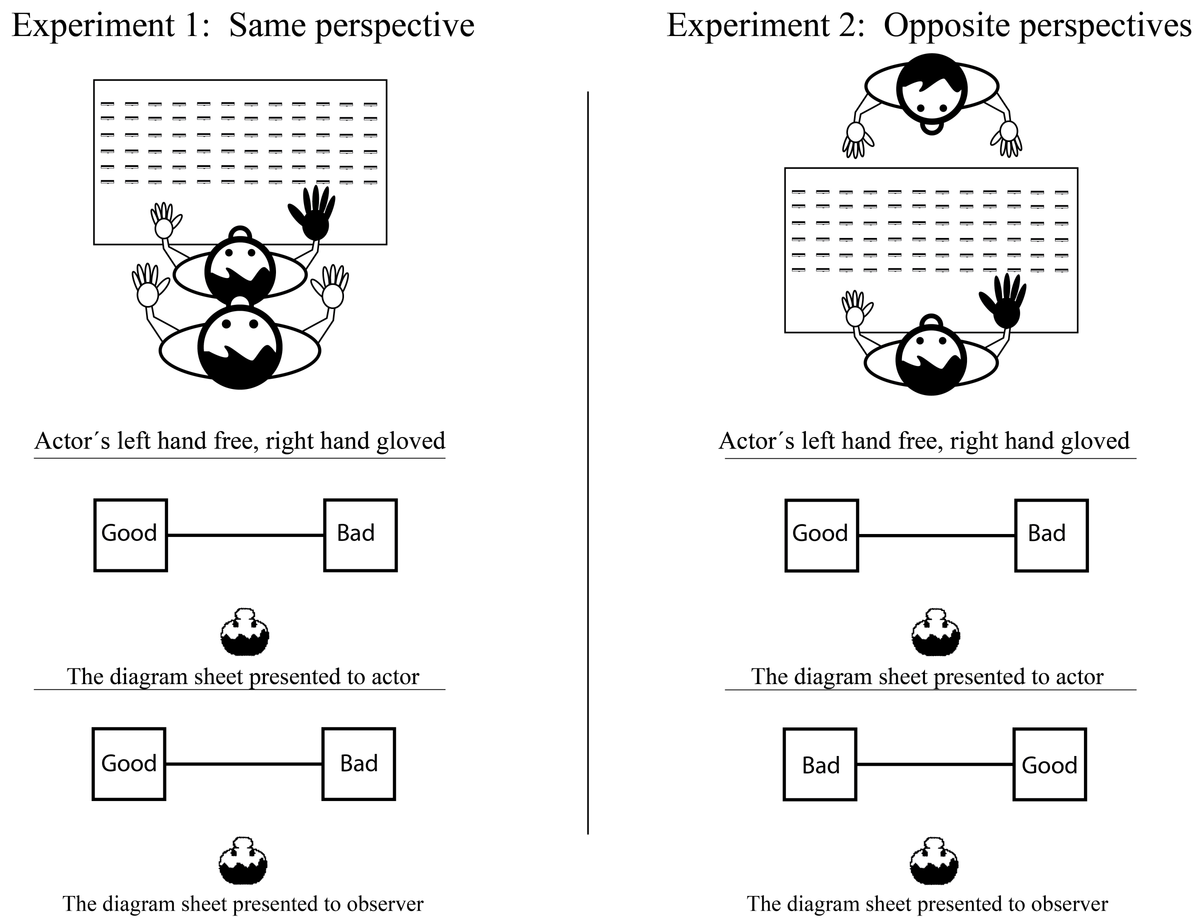

Figure 1. Experimental set up and summary of main results from Experiments 1 and 2. The boxes in the diagrams were blank when presented to the participants. The words "good" and "bad" above indicate the modal responses given by actors (top row of boxes) and observers (bottom row of boxes) in Experiment 1 (left) and Experiment 2 (right).

numbers of actor-observer pairs who agreed in their answers, placing the good animal on the same side of space: 79% of actor-observer pairs agreed in the left ski glove condition, and 71% of pairs agreed in the right ski glove condition. The difference between these conditions was not significant (*Wald*= 0.68, *df*=1, *p*=0.41) by Fisher's Exact test. In each condition, the percentage of pairs who agreed was greater than chance (Left ski glove condition: *Sign Test*, 19 vs. 6, *p*= 0.02; Right ski glove condition: *Sign Test*, 17 vs. 6, *p*= 0.03; fig. 1, left).

In summary, the actors' data show that space-valence associations can be changed (at least temporarily) by brief changes in manual motor experience (see also Casasanto & Chrysikou, 2011). The observers' data show that nearly identical changes in space-valence associations can be effected by brief observation of another person's fluent and relatively disfluent manual motor actions. Since the actor and observer shared the same spatial perspective in Experiment 1, however, it was not possible to determine whether the observers were understanding the actions they observed from their own egocentric perspective, in terms of a relative spatial coordinate system centered on their own body, or from the actor's perspective using a relative coordinate system centered on the actor's body. We conducted Experiment 2 to distinguish these possibilities, and thereby constrain hypotheses about the mechanisms by which this observational learning effect arises.

Experiment 2: Space-valence associations from whose perspective?

Experiment 2 was identical to Experiment 1, with one important difference: the observers watched the actors while standing in front of them, face-to-face, rather than behind them. If observers' space-valence associations were computed from the actors' perspectives then the results of Experiment 2 should closely match those of Experiment 1: Pairs of actors and observers should tend to agree on which side of the diagram is the "good" side and which is the "bad" side. Alternatively, if observers' space-valence associations were computed from their own egocentric perspectives then the results of Experiment 2 should differ from those of Experiment 1: Pairs of actors and observers should systematically disagree about which side of the diagram is the "good" side and which is the "bad" side. It is difficult to predict the results. When describing spatial arrangements, English speakers usually take an egocentric perspective (Tversky & Hard, 2009), but the mere presence of another person who is interacting with the objects in the scene (an actor) increases the proportion of speakers who take the perspective of the actor, specially when attention is driven toward his or her actions (Tversky & Hard, 2009). In Experiment 2, the observer watches, paying close attention to, how the actor interacts with the dominoes, which should favour taking the spatial perspective of the actor. However, the observer does not need to describe the scene. Moreover, there is a high degree of flexibility in perspective choice (Gardner, Brazier, Edmonds, & Gronhom, 2013; see also Stocker, 2012).

Method

Participants Students from the Arts Department of the University of Granada (N = 96; 68 female; average age: 21 years old, age range: 18-30 years) volunteered to participate after providing informed written consent. All participants were right-handed (Mean EHI: 0.85).

Materials and procedure Materials and procedures were identical to Experiment 1, with one exception: the observer in Experiment 2 stood in front of the actor, face-to-face.

Results and Discussion

Actors The actors' results were similar to those of Experiment 1. 96% of actors who wore the glove on their left hand placed the good animal on the right (*Sign Test*, 23 vs. 1, p=0.000003). By contrast, 80% actors who wore the glove on their right hand placed the good animal on the left (*Sign Test*, 19 vs. 5, p=0.007). The difference between the preferences of the right- and left-ski glove groups was highly significant (*Wald*= 8.236, df=1, p=0.004).

Observers Unlike Experiment 1, the observers' responses in Experiment 2 were strikingly different from the actors'. Only 12.5% of observers who watched an actor wearing the glove on the left hand placed the good animal on the right (*Sign Test*, 21 vs. 3, p=0.0003); whereas the actors who wore the left ski glove showed a good=right bias, the observers who watched them showed a good=left bias. Likewise, only 4.2% of observers who watched an actor wearing the glove on their right hand placed the good animal on the left (*Sign Test*, 23 vs. 1, p=0.000003). The difference between the patterns of responses in the two groups of observers was highly significant (*Wald*= 8.85, df=1, p=0.003).

Comparisons of actors and observers The patterns of responses in the actor groups now differed significantly from their corresponding observer groups (Left ski glove condition: *Wald*=8.84, df=1, p=0.003; Right ski glove condition: *Wald*=8.23, df=1, p=0.003; fig. 1, right).

In summary, changing the point of view of the observer caused a dramatic change in the actor-observer agreement between Experiment 1 and Experiment 2. When actors wore the ski glove on the right hand they tended to associate "good" with "left," whereas their observers tended to associate "good" with "right" (and vice versa, for actors who wore the glove on the left hand).

General Discussion

In two experiments, we showed that people's associations between space and valence are strongly influenced by manual motor fluency – but not necessarily by the fluency with which they, themselves, can perform manual actions. Participants assigned to be "actors," who first performed a bimanual fine motor task with either their right or left hand encumbered by a bulky glove, associated "good" with the side of their free hand and "bad" with the side of their gloved hand in a subsequent diagram task. Observers who stood behind the actors during the motor task and shared their spatial perspective showed a nearly identical pattern of responses as the actors. Observers who stood face-to-face with the actors, whose spatial perspectives were reversed from the actors', showed nearly the opposite pattern of responses from the actors they observed: If an actor wore the left glove, and therefore gave a good-is-right response, the observer was likely to give a good-is-left response on the subsequent diagram task. Together, these results show that space-valence associations can be rapidly changed on the basis of asymmetries in manual motor fluency, no matter whether these motor asymmetries are experienced first-hand through motor action or second-hand, through action observation, thereby supporting an important role of observational learning (Bandura, 1977).

One previous study has examined the roles of observation and perspective taking in the computation of space-valence mappings. Participants saw a static picture of a man facing away from the viewer (shared spatial viewpoint) or facing toward the viewer (opposite spatial viewpoint; Kominsky & Casasanto, 2013). In one experiment, which was essentially a manipulation check, the man in the picture was wearing a sling on either his right or left hand, indicating that his arm was impaired, and implying that motor actions on that side of space would be relatively disfluent. Empty boxes were placed symmetrically on the man's left and right, as in the "Bob goes to the zoo" task described here. Participants were explicitly asked to take the man's perspective, and to indicate which boxes he would associate with "good" and "bad." Responses indicated that, when asked to take the man's perspective, they assigned "good" to the side of space nearest his free arm and "bad" to the side of space nearest his impaired arm. This pattern of responses was found no matter whether the man was facing toward or away from the viewer. Whether or not the participant (i.e., the observer) and the man shared a viewpoint, space-valence mappings were computed from the man's perspective rather than the participants' own.

Kominsky and Casasanto's (2013) study left open a question addressed by the present study: do observers spontaneously compute space-valence mappings from other people's spatial perspectives or from their own? The data from Experiment 2 offer a clear answer. Unlike Kominsky and Casasanto's participants, here the observers in Experiment 2 tended to spatialize "good" and "bad" on the basis of the fluent and disfluent actions they saw construed from their own egocentric spatial perspective.

A further question remains regarding the mental representations underlying observers' responses: did responses reflect observers' covert motor simulations of the actors' actions, or did they reflect (non-motoric) associations between locations in space and positive or negative outcomes? These accounts are not mutually exclusive. On the first of these possibilities, observers may have been covertly mirroring the actors' actions, and simulating the hedonic consequences of their simulated right- and left-hand actions. Covert (and sometimes overt) mirroring of others' actions is common, and appears to be highly automatic (Chartrand & Bargh, 1999). When actors fumbled with dominoes using a gloved right hand, observers who shared their spatial viewpoint (Experiment 1) would have covertly simulated performing this disfluent action with their own right hand; by contrast, observers assigned to the opposite spatial viewpoint (Experiment 2) would have simulated performing the disfluent action with their own left hand. On the basis of actions and ipsilateral simulations of actions, actors and observers who were facing the same direction would compute similar space-valence associations; on the basis of actions and contralateral (i.e., mirror-wise) simulations of actions, actors and observers who were facing the opposite directions would compute opposite space-valence associations.

While this motor account would be consistent with "embodied" theories of action understanding (e.g., Buccino et al, 2001), a plausible spatial alternative exists. Perhaps observers learned to associate negative outcomes (i.e., clumsy actions, frustrated actors, falling dominoes) with one side of egocentric space, and positive outcomes (i.e., fluent actions, neatly arranged dominoes) with the other side. This alternative account does not require any motor simulation in the observers, nor does it require observers to infer the hedonic consequences of simulated actions – a process that seems likely to be more subtle and less reliable than perceiving the hedonic consequences of real actions and their outcomes. This spatial account is not without supporting evidence in the literature on imitation (e.g., Watanabe, Higuchi, & Kikuchi, 2013). Actually, Catmur and Heyes (2011) showed that both motor simulation and spatial compatibility have independent and dissociable effects on action production.

The present data do not discriminate between the motor and spatial accounts, though other experimental data could, in principle, tease them apart (e.g., only the motor account requires covert, limb-specific motor simulation, which could potentially be detected by electromyography of the observers' arms, or by Mu-rhythm suppression in their electroencephalography signal). Further studies are needed to determine the extent to which the effect of vicariously experienced motor fluency on space-valence associations is mediated by spatial or motoric representations in the observer.

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References

Bandura, A. (1977). *Social Learning Theory*. Englewood Cliffs, NJ: Prentice Hall.

Buccino, G., Binkofski, F., Fink, G. R., Fadiga, L., Fogassi, L., Gallese, V., Rizzolatti, G. (2001). Action observation activates premotor and parietal areas in a somatotopic manner: An fMRI study. *European Journal of Neuroscience, 13*, 400–404.

Casasanto D. (2009). Embodiment of abstract concepts: Good and bad in right- and left-handers. *Journal of Experimental Psychology: General, 138*, 351–367. doi: 10.1037/a0015854.

Casasanto, D. (2011). Different Bodies, Different Minds: The body-specificity of language and thought. *Current Directions in Psychological Science*, *20(6)*, 378–383.

Casasanto D., Chrysikou E. G. (2011). When left is "right": Motor fluency shapes abstract concepts. *Psychological Science, 22*, 419–422. doi: 10.1177/0956797611401755.

Catmur, C., & Heyes, C. (2011). Time course analyses confirm independence of imitative and spatial compatibility. *Journal of Experimental Psychology: Human Perception and Performance, 37*(2), 409–21. doi:10.1037/a0019325

Chartrand, T. L., & Bargh, J. a. (1999). The chameleon effect: The perception-behavior link and social interaction. *Journal of Personality and Social Psychology, 76*(6), 893–910.

De La Fuente, J., Casasanto, D., Román, A., & Santiago, J. (2011). Searching for cultural influences on the body-specific association of preferred hand and emotional valence. In L. Carlson, C. Hölscher, & T. Shipley (Eds.), *Proceedings of the 33rd Annual Conference of the Cognitive Science Society*. Austin, TX: Cognitive Science Society.

Gardner, M., Brazier, M., Edmonds, C., & Gronholm, P. (2013). Strategy modulates spatial perspective-taking: Evidence for dissociable disembodied and embodied routes. *Frontiers in Human Neuroscience*. doi:10.3389/fnhum.2013.00457

Hertz, R. (1973). The pre-eminence of the right hand: A study in religious polarity. (Originally published 1909). In R. Needham (Ed.), *Right & left: Essays on dual symbolic classification* (pp. 20-41). Chicago: University of Chicago Press.

Kominsky, J. F., & Casasanto, D. (2013). Specific to whose body? Perspective-taking and the spatial mapping of valence. *Frontiers in Cognitive Sciences, 4*:266. doi:10.3389/fpsyg.2013.00266.

McManus, I. C. (2002). *Right hand, left hand: The origins of asymmetry in brains, bodies, atoms and cultures*. London, UK / Cambridge, MA: Weidenfeld and Nocolson / Harvard University Press.

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

Stocker, K. (2012). Toward and embodiment-disembodiment taxonomy. *Cognitive Processing*, *13 (Suppl. 1),* S347-S350.

Tversky, B., & Hard, B. M. (2009). Embodied and disembodied cognition: Spatial perspective taking. *Cognition*, *110*, 124-129.

Watanabe, R., Higuchi, T., & Kikuchi, Y. (2013). Imitation behavior is sensitive to visual perspective of the model: An fMRI study. *Experimental Brain Research, 228*(2), 161–71.