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Role of hand dominance in mapping preferences for emotional-valence words to keypress responses

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ABSTRACT

When a crossed-hands placement (right hand presses left key; left hand presses right key) is used in a two-choice spatial reaction task, the mapping of left stimulus to left key and right stimulus to right key yields faster responses than the opposite mapping. In contrast, de la Vega, Dudschig, De Filippis, Lachmair, and Kaup (2013) reported that when right-handed individuals classified words as having positive or negative affect, there was a benefit for mapping positive affect to the right hand (left key) and negative affect to the left hand (right key). The goal of the present study was to replicate and extend this seemingly distinct finding. Experiment 1 duplicated the design of that study without including nonword "no-go" trials but including a condition in which participants performed with an uncrossed hand placement. Results corroborated the benefit for mapping positive to the right hand and negative to the left hand with the hands crossed, and this benefit was as large as that obtained with the hands uncrossed. Experiment 2 confirmed the importance of the dominant/subordinate hand distinction with left-handed participants, and Experiment 3 showed, with right-handed participants, that it does not depend on which limb is placed over the other. The results verify that the mapping advantage for *positive* → right/*negative* → left is indeed due to the distinction between dominant and subordinate hands. Possible reasons for the difference between these results and those obtained with spatial-location stimuli are considered.

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1. Introduction

When responding to a left or right stimulus with a left or right keypress, executed with the corresponding hand, people are faster when the stimulus-response mapping is left → left and right → right than when it is left → right and right → left [the spatial stimulus-response compatibility (SRC) effect; see Proctor & Vu, 2006, for a review]. A similar correspondence benefit, called the Simon effect, is obtained when left or right stimulus location is task-irrelevant and another dimension such as color is relevant (the Simon effect; Lu & Proctor, 1995; Simon, 1990).

Whether the crucial response factor is left vs. right hand or left vs. right location of the response key is an issue of theoretical importance. This issue has been investigated in several studies by using a crossed-hands placement in which the left key is pressed by the right hand and the right key by the left hand. The consistent finding has been that the SRC and Simon effects are mainly a function of key location and not hand location, implying that response selection is based on spatial response codes. This result has been obtained for visual and auditory SRC tasks (e.g., Anzola, Bertoloni, Buchtel, & Rizzolatti, 1977; Roswarski & Proctor, 2000), and visual and auditory Simon tasks (e.g., Proctor & Shao, 2010; Wallace, 1971). Moreover, when participants press left and right keys with sticks that are crossed so that the responding hand is contralateral to the switch it operates, switch location and not hand location determines compatibility (Riggio, Gawryszewski, & Umiltà, 1986). Thus, the finding that the compatibility effects in two-choice spatial tasks are controlled by response location is consistent and replicable.

Another line of research has provided evidence that people tend to associate words with positive affect to the side of space that corresponds to their dominant hand and words with negative affect to the side corresponding to their subordinate hand. For example, Casasanto (2009) found that right-handed persons tended to draw "good" animals on the right side and "bad" animals on the left side, whereas left-handed

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persons showed the opposite preference. Casasanto and Chrysikou (2011) reported evidence that this association of good with dominant hand is due to motor fluency: Hemiparesis patients who were right-handed prior to the stroke that caused brain damage showed an association of good with right if they had lost use of their left hand but good with left if they had lost use of their right hand. Additionally, students who performed a motor task with a cumbersome glove on the left hand still paired good with right, whereas those who performed the task with the glove on the right hand paired good with left. Casasanto (2011) summarizes the evidence for a preferred mapping of positive affect to dominant hand and negative affect to nondominant hand, arguing more generally for a *body-specificity hypothesis*:

> To the extent that the content of the mind depends on the structure of the body, people with different kinds of bodies should tend to think differently, in predictable ways. This is the *body-specificity hypothesis* (Casasanto, 2009). When people interact with the physical environment, their bodies constrain their perceptions and actions (p. 378).

To investigate whether an association between affective valence and dominant side influences response times (RTs) in Simon-type and SRC tasks, de la Vega, de Filippis, Lachmair, Dudschig, and Kaup (2012) conducted four experiments using lists of words with positive (e.g., *friends*) and negative (e.g., *poverty*) connotations. For right-handed participants, no influence of affective category was found when affect was task-irrelevant (i.e., for word-nonword lexical decisions), but when the words were to be classified according to their affective valence, there was a 24-ms benefit for the mapping positive → right/negative → left over the opposite mapping. Left-handed participants showed an opposite 32-ms mapping preference for positive → left/negative → right. Thus, these results provide evidence of an SRC effect for which the preferred mapping associates positive with the dominant hand and negative with the subordinate hand, but no evidence for automatic activation of a particular response when affect was task-irrelevant.

As in the studies of spatial SRC and Simon effects, the preference of right-handed participants for the positive → right/negative → left mapping could be a function of the hand distinction or the right vs. left position of the response key. Therefore, de la Vega, Dudschig, De Filippis, Lachmair, and Kaup (2013) had right-handed participants perform with a crossed-hands placement in which the right hand operated the left key, and vice versa. In two experiments, which differed only in whether the instructions referred to response hands or response keys, responses were 20-ms faster when positive words were assigned to the right hand and negative words to the left hand, than with the opposite mapping, even though the hands were placed on the left and right keys, respectively. This outcome implies that coding of responses in terms of the dominant hand or its location, rather than in terms of the left or right location of the response key, is the predominant source of the SRC effect for mapping stimulus affect to left and right responses.

Although the body-specificity hypothesis predicts the pattern of SRC effects obtained by de la Vega et al. (2012) and de la Vega et al. (2013), effects of this type that are based on asymmetries of stimulus and response sets are also in agreement with a polarity correspondence principle proposed by Proctor and Cho (2006; see also Proctor & Xiong, 2015). According to this principle, in two-choice tasks, participants code the stimulus and response alternatives as + or − polarity based on relative salience, and performance is best for the mapping that maintains correspondence of the respective code polarities. Proctor and Cho focused on tasks in which left-right spatial coding of responses seems to predominate (mappings of up or down stimulus locations, numerical parity or magnitude, and implicit associations), proposing that the right response is coded as + polarity and the left response as − polarity, rather than the dominant vs. subordinate hand. But, as de la Vega et al. (2013, p. 277) noted, the polarity principle provides "an alternative explanation for the findings presented here" if the plausible assumption is made "that of the two response alternatives, dominant hand vs. non-dominant hand, the dominant hand should be the more salient response alternative." A limitation of this shift to hand dominance as the determining factor, pointed out by Huber et al. (2015) in their article examining embodied markedness of parity, is that such an account is ad hoc and should not be favored without additional evidence.

To summarize, the results obtained by de la Vega et al. (2013) with a crossed-hands placement are counter to those of many other SRC studies using that placement, which instead implicate spatial coding of response keys or goals. Additionally, the results are counter to the emphasis that Proctor and Vu (2006) placed on spatial relations for the coding of response alternatives when they applied the polarity principle to other SRC effects based on coding asymmetries. Therefore, replication of de la Vega et al.'s results in a separate study is essential: Experiment 1 was designed to provide such a replication, determining whether we could verify de la Vega et al.'s (2013) results for right-handers and whether there is any reduction in effect size with the crossed-hands placement compared to the uncrossed one.

If hand dominance is the critical factor, as the body-specificity hypothesis proposes, then left-handed participants should show the opposite pattern of right-handed participants: the mapping of positive → left-hand/negative → right-hand should yield better performance than the alternative mapping, regardless of whether the hands are crossed or uncrossed. Due to the limited availability of left-handed participants, in Experiment 2 we tested this population only with the crossed-hands placement for which they have not previously been tested. Finally, because participants in Experiments 1 and 2 responded with their dominant hand placed over the subordinate hand for the crossed-hands placement, in Experiment 3 we had right-handed participants perform with the subordinate hand left hand on top in order to ensure that vertical placement of the limbs was not the determining factor for the mapping effects.

2. Experiment 1

Experiment 1 was a replication of de la Vega et al.'s (2013) study, with a couple of changes. The initial experiment in de la Vega et al.'s (2012) earlier study used a lexical-decision task, for which a third of the stimuli were nonwords. So, de la Vega et al. (2013) continued to include nonwords as "no-go" trials in their SRC experiments. Inclusion of no-go trials essentially introduces a third response alternative that can interfere with task preparation (Lenartowicz, Yeung, & Cohen, 2011) and lengthen RT on the go trials. Because there is no reason why a preferred mapping of stimulus affect to hand should depend on inclusion of no-go trials, we did not include any.

Also, de la Vega et al.'s (2013) experiments in which responses were made with a crossed-hands placement did not include conditions with an uncrossed-hand placement (although the method seems to have been similar to that of their 2012 study in which the hands were uncrossed). Therefore, in our Experiment 1 we incorporated an uncrossed-hands placement for direct comparison to the crossed-hands placement, allowing determination of whether the right-left hand distinction is the sole factor contributing to the mapping effect. If so, the advantage for the mapping of positive to right hand and negative to left hand with the hands crossed should be similar in size to the advantage obtained with the hands uncrossed.

2.1. Method

2.1.1. Participants

Participants were 80 students enrolled in Introductory Psychology courses at Purdue University who took part for credits toward a course requirement. Handedness was assessed prior to the experiment using the Edinburgh inventory (Oldfield, 1971), for which a positive score indicates dominance of the right hand, with the maximum value being 100. Forty students (22 males, $M = +77.2$; score range: +46 to