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Can you handle this?:

Motor activity, preference, and the Body-Specificity Hypothesis

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Can you handle this?:

Motor activity, preference, and the Body-Specificity Hypothesis

by

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Abstract

Can you handle this?:

Motor activity, preference, and the Body-Specificity Hypothesis

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According to the Body-Specificity Hypothesis, experiences of habitual motor fluency cause people to associate positive valence with their dominant hand side and confer positive valence to items located on their dominant hand side (Casasanto, 2009). Can ongoing motor experience impact this association in the absence of visually lateralized stimuli? In Experiment 1, participants flipped cards using one hand and rated the image on each card with respect to how well it was described by positive or negative personal characteristics. Contrary to our predictions, participant's ratings were not biased by the hand that they used during the trial. In Experiment 2, the task was almost entirely the same, though participants wore a slippery glove on their dominant hand to reduce the perceived motor fluency of the dominant hand. Again, participant's ratings were not biased by the relative motor fluency of the hand used during the trial. Results indicate that ongoing motor activity may not be sufficient to activate body specific preferences in

the absence of visually lateralized stimuli.

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Introduction

Are abstract concepts related to physical experience? Research in the field of embodied cognition has found strong connections between physical experience and concepts. Many concepts are metaphorically associated with regions of egocentric space as evidenced by linguistic and behavioral findings (Gibbs, 1996; Lakoff & Johnson, 1980). Current findings suggest that these associations can develop through physical or cultural experience (Casasanto, 2009; Núñez & Sweetser, 2006). The research presented here explores the question of how ongoing motor activity impacts a particular association that develops from features of habitual motor activity.

How do spatial mappings of abstract concepts relate to physical experience? The primary theories for understanding associations between abstract concepts and space are conceptual metaphor theory (Lakoff & Johnson, 1980), grounded cognition (Barsalou, 1999; Barsalou, 2010; Kaschak, Madden, Therriault, Yaxley, Averyard, Blanchard, & Zwaan, 2005), and the concept of perceptual fluency (Johnston, Dark, & Jacoby, 1985; Reber, Winkielman, & Schwarz, 1998; Reber, Schwarz, & Winkielman, 2004).

Lakoff and Johnson proposed conceptual metaphor theory in their 1980 book *Metaphors We Live By*. The core claim of this theory is that people often understand one conceptual domain in terms of another and that these metaphorical mappings have real consequences for cognitive processes. It is generally the case that these relationships are constructed by mapping abstract domains on to concrete ones and tend to have an analogical structure. Lakoff and Johnson discuss many linguistic examples of conceptual metaphors like TIME IS SPACE and GOOD IS UP and present evidence that these metaphors have consequences for cognitive and linguistic processes and behavior. There has been a substantial amount of research in the intervening 30 years that corroborates this argument (Crawford, 2009; McClintock & Ison, 2004).

A frequently studied spatial mapping of an abstract concept is the mapping between valence and vertical space in such a way that positive valence is mapped to higher regions of egocentric space (e.g. “GOOD IS UP”). We see evidence of this mapping in common idioms ("High spirits", "things are looking up", etc; Lakoff & Johnson 1980; Lakoff & Johnson 1999), gestures (Cienki, 2005; Cienki & Müller, 2008; Cooperrider & Núñez, 2009), and other behavioral measures like RTs to words presented in different locations (Meier & Robinson, 2004). There is evidence that these metaphors are not simply linguistic, but have reliable consequences for cognitive processes (Casasanto & Boroditsky, 2008; Casasanto & Dijkstra, 2010). Theorists have argued that this mapping is not innate, but is developed through a physical experience with the world that is common to all humans -- that of receiving care from parents who are much taller (Lakoff & Johnson, 1980). This is just one example of how regularities in our physical experience can lead to regularities in our conceptual systems. Conceptual metaphors like “GOOD IS UP” shape our daily communication and interaction in powerful ways.

The theory of grounded cognition, most notably advocated by Barsalou (1999), makes an even stronger claim about the mechanisms by which associations between concepts and physical experience support cognitive processes. Barsalou and colleagues (Barsalou, 1999; Pecher & Zwaan, 2005) claim that our conceptual system is composed of "perceptual symbols" that are formed through accumulated perceptual and motor experience and maintained by perceptual and motor systems in the brain. Findings that support this theory suggest that features specific to our perceptual and motor systems as well as consistent features of our environment explicitly shape our conceptual systems and are necessarily activated during conceptual processing (Zwaan, Stanfield, & Yaxley, 2002). So, by this account, whenever a speaker mentions "running" or "throwing" the perceptual and motor regions of the brain that are active when they run or throw are at least partially activated during verbal discussion of those topics (Pulvermüller, 2001). Another consequence of this theory is that features specific to an individual's perceptual and motor systems (like color blindness or hand dominance) impact their conceptual system and, it is predicted, produce detectable differences in conceptual processing and behavior.

It is intuitive to claim that the regions of the motor system that are activated when performing an action are also activated when people think about those actions, but the relationship between actions in space and abstract concepts is less direct. What are the mechanisms by which abstract concepts become associated with regions of space?

The primary mechanism by which abstract concepts become associated with regions of space is processing fluency. Processing fluency is the relative ease with which an item – a perceptual stimulus, a motor action, a memory – is processed (Winkielman, Schwarz, Fazendeiro, & Reber, 2003). There is an extensive literature supporting the claim that stimuli that are easier to process are perceived as having greater positive valence (Reber, Schwarz, & Winkielman, 2004; Whittlesea, 1993). When the font used is difficult to read the message conveyed in the text is perceived to be less positive, independent of actual semantic content (Reber, Schwarz, & Winkielman, 2004). Features that improve the fluency with which an item is processed -- visual clarity, semantic priming, familiarity, etc. -- increase the amount of positive affect associated with that item. In this way the familiarity of regularities in physical and cultural experience support cognitive and behavioral preferences that reflect those regularities.

These mechanisms suggest that asymmetries in processing fluency within the body's motor system could have lasting consequences for conceptual systems. Recent research by Daniel Casasanto (2009) has explored this question in the context of hand dominance. He found that people associate positive valence with their dominant hand side and negative valence with their non-dominant hand side. These data suggest that the asymmetrical motor fluency inherent to having one dominant hand creates this association between egocentric space and valence. He calls this the Body-Specificity Hypothesis (BSH) as the specifics of the association between space and valence depend on a feature of the particular bodies under study. Daniel Casasanto and his colleagues are responsible for the vast majority of the research investigating the BSH thus far.

In his original set of studies on this topic, Casasanto (2009) used a couple of different methodological approaches to investigate the mechanisms by which the association between valence and horizontal space is developed and maintained. The methods employed in Experiments 1-3 are very similar. In the first study reported, Casasanto addressed the question of whether the mapping from valence to horizontal space is universal or body-specific. In these experiments participants were asked to draw one animal in each of two boxes, located either to the left and right of (Experiments 1-2) or above and below (Experiment 1) a cartoon figure. They were told that the cartoon figure thought that one of the animals was "good" and the other was "bad". Participants were instructed to "draw the 'good' animal in the box that best represents good things and the ‘bad’ animal in the box that best represents bad things". The proportion of "good" animals drawn in the top box in the vertical condition and in the right box in the horizontal condition was analyzed. Casasanto found that both right- and left-handed participants in the vertical condition consistently (89% and 83%, respectively) put "good" animals in the box above the cartoon figure and "bad" animals in the box below. However, right- and left-handed participants in the horizontal condition tended to draw the "good" animals in the box on their dominant hand side -- 67% of right-handed participants drew the "good" animal on the right, 74% of left-handed participants drew it on the left. Casasanto replicated the finding from the horizontal condition in Experiment 2 and confirmed that participants do not attribute their task behavior to their hand dominance using a debriefing questionnaire. This initial finding strongly supports the hypothesis that the mapping between valence and horizontal space is body-specific, at least when dealing with explicitly positive and negative stimuli in a binary forced choice task.

These initial experiments established the finding that the mapping between valence and horizontal space is body-specific, but these findings do not rule out the possibility that the motor activity of writing responses is necessary to activate body-specific preferences. Experiment 3 was designed to see if participants exhibit the same strong, body-specific associations when they respond without using their hands. Experiment 3 used the exact same experimental protocol from Experiment 2 with spoken, rather than written, responses to visually lateralized stimuli. As in Experiments 1 and 2, both right- and left-handed participants tended to place "good" animals on their dominant-hand side (58% and 86%, respectively). Results from Experiment 3 suggest that body-specific space-valence mappings are not merely an artifact of ongoing motor activity.

While these initial studies laid the foundation for the BSH, the remaining two studies reported in Casasanto 2009 take a more rigorous and nuanced approach by using more than one trial (Experiments 4 & 5), an implicit test of "valence" (Experiments 4 & 5), and a test of body-specific preferences in non-arbitrary real-world decisions (Experiment 5). The experimental protocol and stimuli employed in the experiments reported later in this paper are modeled closely after the experimental design of Experiment 4.

Since Experiments 4 and 5 from Casasanto 2009 lay the foundation for the studies reported in this paper, it makes sense to discuss their methods in detail. Both of these studies employ the same basic experimental protocol -- a worksheet with pairs of comparable visual (Experiment 4) or linguistic (Experiment 5) items separated by a long line. Each pair was labeled with the feature or category on which they should be compared. In Experiment 4 participants viewed 12 pairs of novel alien figures of equal visual complexity, called Fribbles (created by Michael J. Tarr, Brown University, www.tarrlab.org). They responded to questions about personal characteristics by circling one Fribble in each pair. Participants answered questions about a total of 4 positive personal characteristics (i.e. honesty, intelligence, attractiveness, and happiness). The questions were of the form "Circle the Fribble who looks more/less (personal characteristic)". Half of the participants received worksheets with "more" and half received worksheets with "less". The majority of both right- and left-handed participants showed a preference for attributing greater positivity to Fribbles on their dominant hand side (54% and 65%, respectively). Specifically, participants who were asked to pick the Fribble who was "more [positive characteristic]" tended to circle the Fribble on their dominant hand side and participants who were asked to pick the Fribble who was "less [positive characteristic]" tended to circle the Fribble on their non-dominant hand side. These results indicate that the position of an item in egocentric space impacts it's perceived valence when considering items with implicit valence.

Experiment 5 tested the question of whether position in egocentric space impacts the perceived valence of equivalent real-world items. The worksheet employed featured 6 pairs of brief, similar biographical descriptions of equivalently qualified job candidates and 6 pairs of brief descriptions of competing brands of common household products in the place of aliens and job titles and product category names, respectively, in the place of questions about personal characteristics. Participants were instructed to circle the description of the candidate or item they would choose to hire or buy, respectively. This design targets preference directly without any linguistically mediated discussion of valence. Of the participants who showed a preference, the majority of both right- and left-handers tended to prefer people and items located on their dominant hand side (52% and 74%, respectively). This result indicates that location in egocentric space is sufficient to activate body-specific associations and support preferences for equivalent real-world items in the absence of any linguistic representations of valence.

These initial findings established the Body-Specificity Hypothesis in the literature and laid the groundwork for a flurry of follow-up research, much of which also comes from Casasanto and colleagues. The studies reported in Brunye, Gardony, Mahoney, & Taylor (2011), discussion to follow, focused on the role of location in egocentric space in activating body-specific associations, while later studies, including those reported in this paper, tend to focus on the role of the motor system in activating body-specific associations.

In 2010, Casasanto and Jasmin conducted a study to see whether people spontaneously display body-specific preferences in their manual gestures when talking about topics with positive or negative valence (Casasanto & Jasmin, 2010). Specifically, they analyzed gestures produced by presidential candidates during the 2004 and 2008 presidential debates. They found that the two left-handed candidates tended to gesture with their left hand when talking about concepts with positive valence and their right when talking about concepts with negative valence and vice versa for the right-handed candidates. This finding suggests that the activation of body-specific associations of space and valence produced when thinking about topics with positive or negative valence is strong enough to support spontaneous congruent motor behavior when none is required. This finding also suggests that visually lateralized items (other than the body itself) are not required to observe evidence of body-specific associations between space and valence.

Other research groups have also explored questions regarding the nature of body-specific associations of space and valence. Brunye and colleagues (Brunye, Gardony, Mahoney, & Taylor, 2011) tested the hypothesis that body-specific associations would cause people to make systematic errors when remembering locations of events with positive and negative valence. In this study, participants viewed a map and learned about a series of good, bad, and neutral news events that occurred at different locations on the map. Participants were prompted to recall the location of the events and the distance between the actual and remembered locations of the event were calculated. They found that participants tended to recall locations of positive events as being further to their dominant hand side than they were at encoding and the locations of negative events were recalled as being further to their non-dominant hand side. This imaginative and powerful new paradigm not only introduced a more naturalistic operationalization of valence (good and bad events), but also incorporated a continuous, rather than categorical, measure of location in egocentric space. These findings suggest that body specific associations impact performance on tasks that use continuous visual stimuli.

Later, in 2011, Casasanto and Chrysikou published two follow-up studies that tested to see whether recent motor fluency experience, specifically experiences that differed from habitual experience, had an impact on the association between egocentric space and valence. They tested the preferences of patients who had recently suffered a debilitating stroke resulting in paralysis on their dominant hand side and of healthy participants whose dominant hands had been temporarily handicapped. They found that stroke patients who had lost the use of their dominant hand and people who had recently had temporary, strongly disfluent experiences with their dominant hand were inclined to associate positive items with their most recently (rather than habitually) fluent side. This finding suggests that body-specific associations are responsive to recent experience with the physical world. This finding has yet to be replicated. Furthermore, this finding that recent motor activity has a substantial, if temporary, impact on body-specific preferences in combination with the findings from Casasanto and Jasmin (2010), suggests that the motor system is actively engaged with body-specific preferences during reasoning tasks.

Though very little is understood about the relative importance of habitual and recent experience in forming associations between space and valence, findings from a study by Casasanto and Dijkstra (2010) offer some insight. Casasanto and Dijkstra (2010) looked at the impact of ongoing motor activity on a recall task for memories with positive and negative valence using the "GOOD IS UP" conceptual metaphor. Participants were instructed to move marbles between two sets of two boxes, one high, one low, one on either side of the participant. They were asked to move the marbles from low to high or high to low while recalling positive or negative autobiographical memories. Casasanto and Dijkstra found evidence that memories are easier to recall when the valence of the memory and the direction of movement match the GOOD IS UP space-valence association. Specifically, Casasanto and Dijkstra found that participants were faster to recall positive memories when moving marbles upwards than when moving marbles downwards and more likely to retrieve positive memories in response to neutral prompts when moving marbles upwards. This study illustrates the potential impact of ongoing motor activity on tasks designed to look at other kinds of associations between space and valence.

These experiments have established that body-specific associations between valence and egocentric space have a significant impact on a variety of behaviors under a range of circumstances. These associations impact (a) where people choose to place items with explicit valence, (b) how people perceive items with implicit valence that are laterally arranged in egocentric space, (c) which hand people use to produce gestures while talking about positive and negative topics, (d) decisions about and memory for both arbitrary neutral items and real world items and events, and (e) behavior on tasks that employ categorical or continuous definitions of egocentric space. We also know that current motor activity is not required to activate body-specific associations, but these associations are quite responsive to recent changes in relative motor fluency.

While the literature on the Body Specificity Hypothesis has already investigated a large number of research questions, many remain unanswered. Most of the previous research has employed visually lateralized stimuli or no visual stimuli at all. Though this situation may be representative of the general distribution of items in the visual world, the Body Specificity Hypothesis claims that these associations are formed through the inherent lateralization of the body, not some systematic distribution of items in the visual world. This suggests that visually lateralized stimuli are not necessary so long as the inherent lateralization of the body is apparent. Is this the case when visual stimuli are presented in the center of the visual field?

Another open question in this literature concerns the relationship between ongoing, recent and habitual motor experience. The Body Specificity Hypothesis suggests that processing fluency during habitual motor experience is crucial for the development of body specific associations. However, findings from Casasanto and Chrysikou (2010) and Casasanto and Dijkstra (2010) suggest that both recent and ongoing motor experience can impact performance on tasks that provide evidence of associations between space and valence. Previous research has also found that ongoing motor activity is not necessary for observing body-specific effects, though this is not evidence that ongoing experiences of motor fluency that are different from habitual motor fluency will not impact body-specific preference behavior. Can ongoing experiences of motor fluency that differ from habitual experiences of motor fluency temporarily reverse body-specific associations?

The present research will begin to address these questions by using centered, rather than lateralized, visual stimuli and requiring participants to produce ongoing motor activity. Based on previous studies where participants have shown evidence of body-specific preferences in the absence of visually lateralized stimuli and based on studies that have shown that ongoing and recent motor experiences impact associations between space and valence, we predict that, in the absence of visually lateralized stimuli, participants will show body-specific preferences based on the side of their body that is currently active.

Experiment 1

This experiment was designed to determine whether ongoing motor activity is sufficient to generate body-specific responses in a task that uses centered, rather than lateralized, visual items. Given body-specific associations are formed through habitual experiences of relatively greater motor fluency with one of the hands, not regularities in the location of positive and negative items in the visual field, it is reasonable to predict that selectively activating one hand will also activate the valence typically associated with that hand in the absence of visually lateralized stimuli.

Experiment 1 employed a task that was modeled after the task used in Experiment 4 from Casasanto 2009. The original task was modified to fit a laboratory setting, involve manual manipulation of test items, include more test items, eliminate visual lateralization, and to allow participants to make graded, rather than binary, responses. We instructed participants to use one hand to manipulate items before rating the item on a 7-point scale. Each participant performed the task with their right and their left hands. We predict that participant's responses will show that items that they handle with their dominant hand are perceived as having stronger positive traits. We also predict a slight positivity bias resulting in higher positive ratings for items with positive valence.

METHOD

Participants

Forty-eight students (aged 17-28, average age 19.8) from the University of Texas at Austin participated in exchange for course credit. No measures were taken to recruit a balanced set of right- and left-handers. Forty-two of our forty-eight participants indicated that they were right- handed in the debriefing materials following our experiment. We used the short version of the Edinburg Handedness Inventory (EHI; Oldfield, 1971) to measure direction and extent of handedness in addition to verbal report. The EHI features questions about hand preference in a variety of tasks. Scores from the inventory range from -100 (strongly left-handed) to +100 (strongly right-handed). Right-handed participants produced an average score of 85 and left-handed participants produced an average score of 53.3. All participants participated in all experimental conditions. Due to an insufficient number of left-handed participants, all analyses were performed on the data from right-handed participants.

Materials

Visual stimuli

We used a set of images of aliens called "Fribbles" produced by Michael J. Tarr (Brown University, www.tarrlab.org). These images were normed for visual complexity and grouped into families of three based on similarity of features. For our study we selected a subset of 24 Fribbles by randomly selecting two Fribbles from each family. We printed two sets of the selected Fribbles -- one set facing to the right, another facing to the left -- onto 5.5in x 6.5in cards. The cards were laminated to protect them from wear.

The cards were pseudo-randomly sorted into 3 decks - one for practice (8 cards) and two for the experimental blocks (20 cards each). Half of the cards in each deck faced to the right and right- and left-facing versions of the same Fribble were never placed in the same deck. An effort was made to make sure that Fribbles from the same family were not placed in consecutive order. The pairing of card deck with experimental block was counterbalanced across participants. All participants viewed the same practice deck.

Verbal stimuli

All trials used a modified version of the sentence frame used in Experiment 4 from Casasanto 2009 (e.g. "How (personal characteristic) does this Fribble look relative to the average Fribble?"). The original sentence frame could not be used in our experiment since we modified the original experimental design, which featured pairs of Fribbles, to a single- Fribble design. A total of 20 personal characteristics (10 with positive valence, 10 with negative valence) were tested, including the items from the original study in Casasanto 2009 (e.g. intelligent, happy, attractive, honest) and their antonyms. Questions were presented in one of four pseudo-random orders such that no more than 3 traits of the same valence appeared in sequence and antonyms (e.g. "honest" and "dishonest") were not presented in consecutive order. All 20 traits were presented in both experimental blocks, though trait sequence and trait-Fribble pairing were shuffled across the experimental blocks.

Procedure

Participants were seated at a table facing the experimenter. Participants looked through a deck of 8 cards to familiarize themselves with the Fribbles while the experimenter described the structure of the experiment. Participants completed four trials in a brief practice block using methods identical to the experimental blocks.

At the beginning of each block participants were instructed to sit on one of their hands. Participants were instructed to switch their hands between each block. Order of hand use was counterbalanced across participants. At the outset of each block a deck of Fribbles was placed face-down on the table mid-way between the participant and the experimenter, roughly aligned with the participant's mid-line. Participants initiated each trial by flipping over a card from the deck and placing it Fribble-side up on the table in front of the main deck (closer to the participant but still aligned with their mid- line). As soon as the card was placed on the table, the experimenter read a question of the form "How (personal characteristic) does this Fribble look relative to the average Fribble?" aloud to the participant. Within a block a participant answered 20 questions (10 positive traits, 10 negative traits). The same 20 questions were asked in both experimental blocks (see "Materials" section for details about counterbalancing). In each experimental block each question was randomly paired with a single Fribble. Participants were instructed to use a seven-point scale "where one is "much less (personal characteristic)" and seven is "much more (personal characteristic)"" to respond. The experimenter entered the participant's response on a spreadsheet before initiating the next trial. Each participant completed a practice block (4 trials) and two experimental blocks (20 trials each).

Following the final experimental block participants completed a debriefing questionnaire, a demographic questionnaire, and a short version of the Edinburgh Handedness Inventory.

RESULTS

In Experiment 1, 42 right-handed participants each rated a series of 40 Fribbles on a scale from 1 to 7. We eliminated one participant whose responses had a standard deviation of less than 0.5. The following analyses are based on data from 41 participants.

One consequence of using a rating scale paradigm where smaller numbers indicate that a Fribble is "much less (personal characteristic)" and larger numbers indicate that a Fribble is "much more (personal characteristic)" is that the ends of the rating scale mean different things depending on the trait valence. This incidental inconsistency in the mapping from rating to valence in our experimental design also makes the raw data difficult to interpret visually. In order to correct for this issue, the rating data from the trials with negative valence were transformed so that higher numbers indicate more positive ratings.

Previous studies investigating this hypothesis found an interaction between item valence and location in egocentric space. In the context of our study, the Body-Specificity Hypothesis suggests that we should find an interaction between item valence and hand in use (as hands are lateralized in egocentric space).

We did not analyze data from left-handed participants, so the right hand is the dominant hand for the purposes of these data. Every participant provided data for both the left- and the right-hand conditions.

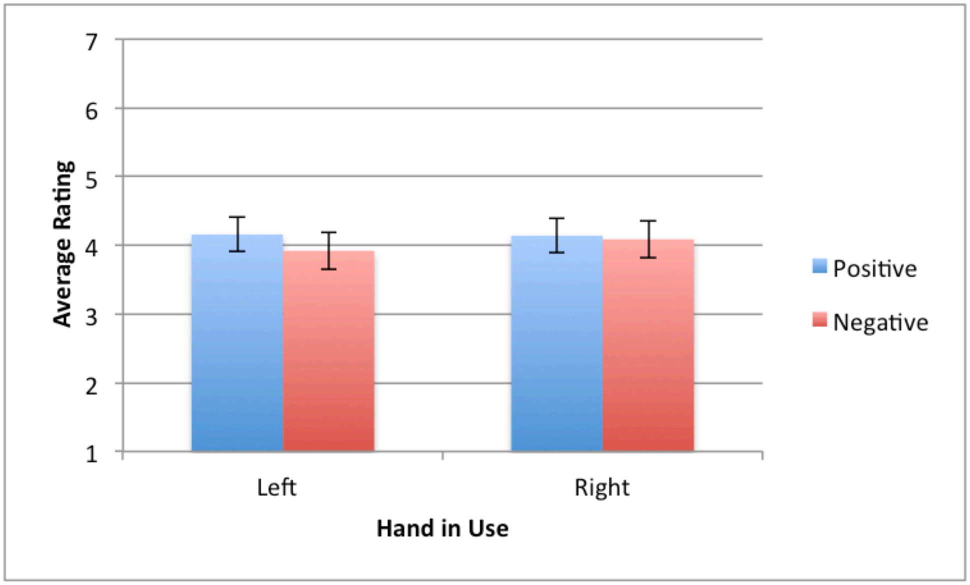

Figure 1: Mean rating by trait type (positive or negative) and hand in use (left or right) from 41 right-handed participants.

The mean ratings for all conditions were very similar. Though there seems to be a very slight trend for positive stimulus items to be perceived as more positive in general, it is not substantial enough to be interpreted as evidence of a positivity bias (see Fig.1). For positive traits, participants assigned an average rating of 4.16 on a 7-point scale when using their left hand and 4.14 on a 7-point scale when using their right. For negative traits, participants assigned an average rating of 3.92 on a 7-point scale when using their left hand and 4.09 on a 7-point scale when using their right hand.

The subject means from the transformed ratings data were analyzed using a repeated measures ANOVA with the interaction between trait valence and hand in use as a within subjects factor. No significant main effects or interactions were observed ($F < 9.649$, $df = 1, 40$).

In the original studies reported by Casasanto, participants performed far fewer trials. It is possible that body-specific effects disappear after a large number of trials as participants develop their own strategy for completing the task. In order to test this possibility, we ran a repeated measures ANOVA on the first experimental block for each participant with trial valence as a within subjects factor and hand in use as a between subjects factor. No significant main effects or interactions were observed ($F < 0.667$, $df = 1, 41$).

Discussion

In this experiment we expected to find that the hand that participants used to interact with the stimulus items would bias participant's ratings for those items in accordance with previous findings from the literature on body-specific effects. We did not find this effect in our data.

While it is impossible to conclude from a single study whether this null effect is a failure of our experimental design or a true failure to replicate, there are a few features of our experimental design that could be problematic. One experimental design feature that might be necessary to elicit body-specific preference behavior is a difference in relative motor fluency. Even though previous studies have shown that participants do not need to be actively engaged in an activity with obvious asymmetries in motor fluency (e.g. writing) in order to observe body-specific preferences in tasks with visually lateralized items, all previous studies from this literature that require motor involvement use tasks that maintain asymmetries in motor fluency. It could be the case that ongoing motor experience is actually having an impact on responses in our study, but since both hands are equally good at flipping cards, the difference in relative motor fluency is not salient and both hands are effectively in a “high motor fluency” condition. If this is the case, participants with one handicapped hand should show body-specific preferences based on their current handicap.

Experiment 2

Experiment 1 raised questions about the necessity of differences in relative motor fluency in ongoing motor activity for activating body-specific preferences and failed to provide conclusive answers to the original research questions. Experiment 2 modified the experimental design used in Experiment 1 slightly to make one hand less fluent than the other in order to address the question about the role of relative motor fluency in body-specific preference behavior. We predict that participants will rate positive items that they manipulate with their unhampered (non-dominant) hand more positively than those manipulated with their handicapped (dominant) hand. Again, we also predict a slight positivity bias resulting in higher positive ratings for items with positive valence.

METHOD

Participants

Sixty University of Texas at Austin undergraduates (aged 17-38, average age 19.8) participated in this experiment in exchange for course credit. Data from 7 of these participants were excluded because the participants correctly guessed the experimental hypothesis. Data from 3 other participants were excluded due to experimenter error.

Right-handed participants produced an average score of 77 (out of 100) on the Edinburgh Handedness Inventory (EHI), while left-handed participants produced an average score of 70. General recruitment from the psychology subject pool did not yield a sufficient number of left-handed participants for our analyses to have sufficient statistical power, so data from 3 left-handed participants were excluded from further analysis.

Materials

The materials used in this experiment were exactly the same as the materials used in Experiment 1.

Procedure

The experimental procedure used in this experiment was exactly the same as the procedure used in Experiment 1 with the exception of one crucial change. Participants were given a slippery plastic glove to wear on their dominant hand for the duration of the experiment. Information about participant's handedness was obtained by surreptitiously observing which hand participants used to sign the consent form at the outset of the experiment. Observed handedness was compared to participants performance on the EHI. There were no cases where participant's observed handedness differed from the handedness indicated by their EHI score. Once participant’s handedness was determined, experimenters instructed participants to "please place this glove on your right/left hand". The phrase "dominant hand" was not mentioned.

RESULTS

In Experiment 2, 47 right-handed participants each rated a series of 40 Fribbles on a scale from 1 to 7. None of the participants produced responses with a standard deviation of less than 0.5, so all participants were used in the following analyses.

As in Experiment 1, the rating data from the trials with negative valence were transposed to make increases in the rating scale indicate greater relative positivity for both positive and negative trials. Higher numbers indicate increasingly positive responses in the transformed data set.

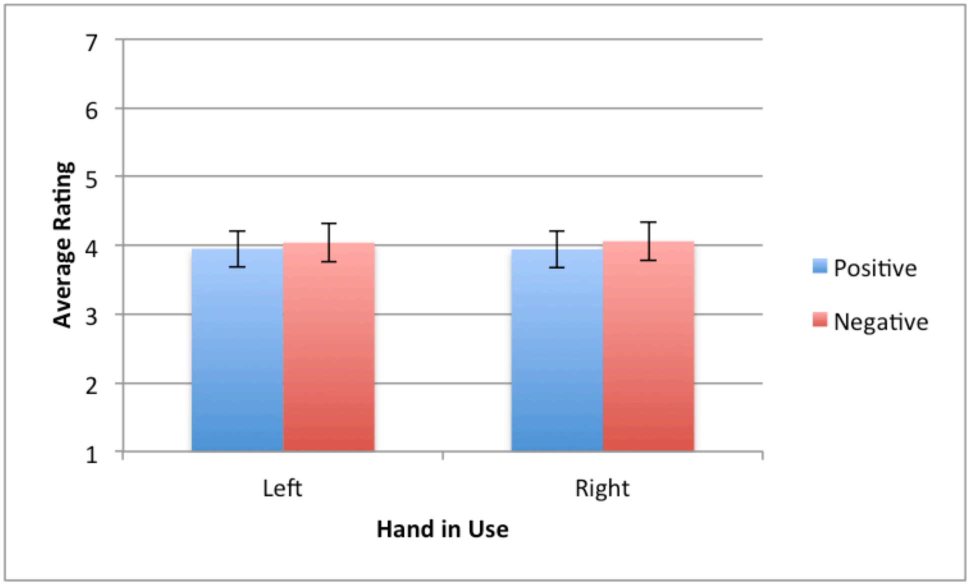

Figure 2: Mean rating by trait type (positive or negative) and hand in use (left or right) for 47 right-handed participants with right-hand handicaps.

As in the previous study, mean ratings for all conditions were very close (see Fig. 2). However, unlike Experiment 1, there was a slight, though entirely inconclusive, tendency for items with negative valence to receive more strongly positive ratings. For positive traits, participants assigned an average rating of 3.95 on a 7-point scale when using their left hand and 3.94 on a 7-point scale when using their right. For negative traits, participants assigned an average rating of 4.04 on a 7-point scale when using their left hand and 4.06 on a 7-point scale when using their right.

The subject means from the transformed ratings were analyzed using a repeated measures ANOVA with the interaction between trait valence and hand in use as a within subjects factor. No significant main effects or interactions were observed ($F > 7.479$, df = 1, 46).

Discussion

Experiment 2 was designed to see whether a clear difference in relative motor fluency is required to observe body-specific effects in the absence of visually lateralized stimuli. No body-specific effects were observed.

While it is possible that the physical handicap used to manipulate relative motor fluency was not sufficiently handicapping to produce an effect, it is more likely that other features of the experimental design are problematic for body-specific associations. It is most likely that one or more of the experimental design features that were a departure from previous studies – lack of visually lateralized stimuli, the use of a rating scale – is problematic for activating body-specific associations. It could also be the case that the center of egocentric space has it's own particular associations with valence. Further research is required to understand how these factors impact body-specific associations.

General Discussion

In the studies reported in this paper we tested the hypothesis that ongoing motor activity activates body-specific associations between space and valence in a way that the hand in use biases the perceived valence of an item. We also tested to see if current motor experience impacts perceived valence when the relative motor fluency of one's current motor experience differs from habitual experience.

Based on previous findings from this literature, we predicted that people would perceive an item to be more positive than average when they had interacted with the item with their dominant hand (Experiment 1) or currently fluent hand (Experiment 2) and more negative than average when they interacted with the item with their non-dominant hand (Experiment 1) or currently disfluent hand (Experiment 2). Based on findings from rating tasks in general, we also predicted that participants would show a slight positivity bias resulting in higher positive ratings for items with positive valence irrespective of hand in use. In the context of our experimental paradigm we predicted that an item would receive higher positive ratings when participants interact with it with their dominant, rather than non-dominant, hand. Our data do not show any of the predicted patterns.

These experiments follow from several of the studies from the literature on associations between space and valence, so it is surprising that the data reported here do not show evidence of body-specific associations. Previous studies found support for the Body-Specificity Hypothesis under conditions similar to many of those present in our study. Our study employed an experimental paradigm modeled after the paradigm used in a previous study (Casasanto, 2009), including the same visual stimuli and very similar verbal stimuli. Though the experimental design features that differed from those used in previous studies were motivated by previous findings, they are the most likely explanation for the failure to observe body-specific effects in our studies.

The spatial arrangement of visual stimuli used in our experiment differed substantially from spatial arrangements used in previous experiments. Previous experiments used pairs of items presented on a horizontal left-right axis (Casasanto, 2009; Casasanto & Chrysikou, 2010), square city maps with labeled event locations (Brunye, Gardony, Mahoney, & Taylor, 2011), or no visual stimuli at all (Casasanto & Jasmin, 2011). These findings suggest that body-specific associations are activated when people consider pairs of visual items, as well as single items presented in a continuous space. Our experiments used single, visually centered items, which do not provide an easy one-to-one mapping for participant's to make between their hands and regions of space. Arrangements of visual stimuli that provide a straightforward mapping from hand to region of space likely facilitate activation of body-specific preferences. One way to test this hypothesis would be to conduct an experiment similar to those reported in this paper in which single items are presented on one or the other side of the visual field. Further research is necessary to determine the importance of the spatial arrangement of visual items (when present) in activating body-specific associations.

Another substantial methodological deviation from previous studies is response type. The studies reported in this paper require participants to respond using a 7-point scale. While majority of the studies in this literature used a binary forced-choice design when presenting visual stimuli, there is evidence that body-specific preferences are expressed when graded responses are possible (Brunye, Gardony, Mahoney, & Taylor, 2011). While a 7-point scale is not technically continuous, it is significantly more graded than a binary choice, so the results from Brunye et al (2011) suggest that insofar as rating scales are continuous they should not necessarily pose an obstacle for body-specific responses. However, it might be the case that participants do not treat rating scales as continuous and that their decision-making behavior is different when they use rating scales rather than continuous or categorical binary response methods. It is difficult to test this question using the single-item experimental design used in the present experiments, but other experimental paradigms may be more fruitful in this regard.

The specific ongoing motor activity used in the studies reported here may not have been strong enough. The studies that used ongoing (Casasanto & Dijkstra, 2010) and recent (Casasanto & Chrysikou, 2010) motor activity employed motor tasks that were either continuous or extremely difficult. The ongoing motor task employed in the current studies was repetitive, brief, and only mildly difficult. Further research can employ extremely difficult or continuous motor activities to determine whether intensity of motor activity is a factor in body-specific preferences.

Other potential explanations for the failure to find body-specific preferences in the current study concern assumptions about the nature and structure of body-specific associations. The core assumption of the main hypothesis in the reported research is that laterality in the body and laterality in the spatial arrangement of visual items activate body-specific associations equally well. It is logical to assume that when an association that is formed through a particular type of bodily activity will be activated by the same kind of bodily activity. But it could be that participants are more likely to attend to aspects of their physical experience that are less stable over time. In this case participants would, on average, attend to and process laterality in their environment more deeply than laterality in their own bodies. While this is an interesting question to consider in the broader context of the literature on this topic, it is less likely that participants in the current experiments were not attending to the laterality of their own bodies as the experimental paradigm used drew attention to the spatial arrangement of the body.

The topic of attention to external stimuli raises another concern about design assumptions. The modifications made to previous experimental designs to produce the current experimental design rely on the assumption that there is no categorical behavioral difference between body-specific preferences in tasks that involve visual stimuli and those that do not. However, it may be the case that attending to a visual stimulus engages a set of spatial reasoning processes that differ from those engaged when people are not attending to visual stimuli. When people have a visual item to anchor their focus, they may be more likely to perceive the scene and make judgments relative to that item rather than other potential reference points, including their own bodies. Future research can investigate the question of whether people are more likely to express body-specific preferences when using one frame of reference rather than another.

Another assumption worth scrutinizing is the assumption that body specific associations are activated equally well by spatial, motor, and conceptual stimuli. Is it just as likely that something located on your dominant hand side will be perceived as positive as it is that something perceived as positive will be preferentially placed on your dominant hand side? This is only one of many important questions that further research must address.

Many of the issues raised by this research are issues that the field of embodied cognition needs to address more generally. While there is a substantial amount of research that suggests that experiences in the physical world impact cognitive processes, the relationship between current and frequent experiences is not well understood. What are the mechanisms by which regularities in our experiences become regularities in our cognitive systems and what conditions are necessary for current experiences to impact cognitive processes? The field of embodied cognition has identified several key relationships between our physical experiences and cognitive systems, but the mechanisms by which they are developed and maintained and the conditions under which they impact behavior are only beginning to be understood.

While many questions remain about the nature of body-specific associations, the research presented here suggests that the relationship between ongoing motor activity and motor-fluency based associations may be less straightforward than previous research would suggest. Further research is necessary to determine exactly how associations motor and spatial systems work together to support body-specific associations between space and valence.

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