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Effect of Cultural Environment and Handedness on Spatial-valence Association

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Abstract. This study investigates the interaction between cultural-linguistic environment and handedness in shaping spatial-valence associations, addressing a key debate in embodied cognition regarding the relative influence of body-specific experience (nature) versus cultural-linguistic context (nurture). We compared English monolinguals, whose language reinforces “right = good, left = bad” metaphors, with Chinese monolinguals, whose language lacks strong spatial-valence connotations. Using a 2×2 between-subjects design (culture × handedness), we measured reaction times, accuracy, and subjective preferences in a spatial-emotional matching task. Results indicate that while right-handed English speakers exhibited stronger spatial-affective congruence consistent with the Body-Specificity Hypothesis, Chinese speakers would show attenuated effects, suggesting that cultural-linguistic context can modulate body-based preferences. These findings highlight the nuanced role of culture in embodied cognition and imply that psychological tools relying on spatial-valence mappings should account for cultural and handedness differences. This study contributes to the theoretical understanding of how nature and nurture interact in cognitive processing and offers practical insights for cross-cultural psychological assessment and intervention.

Keywords: embodied cognition, Body-Specific Hypothesis, spatial-valence association, cultural diversity, handedness.

1. Introduction

People often connect space with feelings, for example, thinking “up” is good and “down” is bad. This comes from the idea of embodied cognition, which says that our bodies shape how we think. The Body-Specificity Hypothesis (BSH) explains that a person’s strong hand changes how they link space with emotions. Right-handers usually think the right side is good and the left side is bad, while left-handers often show the opposite [1,2]. But research shows that these patterns are not the same in every culture. Language and culture can make these links stronger or weaker. In English, the word “right” can mean both a direction and something positive, like “the right answer.” In Chinese, left and right do not carry such strong good–bad meanings, so Chinese speakers often show weaker links between space and emotions. This brings up a key question: are these connections mostly from the

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body (nature), or from culture and language (nurture)? This question matters for theory and practice, because many psychology tools, such as association tests or emotion training, assume everyone has the same left–right emotion patterns [3]. The aim of this study is to test how culture and handedness work together to shape space–emotion links. We will compare English speakers, who have strong "right = good, left = bad" patterns, with Chinese speakers, who do not. We will also test right- and left-handers to see if body or culture has the stronger effect, and whether cultural priming can change body-based preferences. This study will help us learn if space–emotion links are shaped more by the body or by culture.

2. Overview

Research on embodied cognition shows that our body shapes how we think about abstract ideas. The Body-Specificity Hypothesis (BSH) says that a person's dominant hand affects how they connect space and emotions [1]. For example, right-handers usually link the right side with "good" and the left side with "bad." Left-handers often show the opposite pattern. These effects appear in reaction time tests, association tasks, and even in everyday language [2].

But later research shows that these effects are not the same everywhere. Culture and language can change how strong these left–right patterns are. In English, the word "right" often means both a direction and something positive, like "the right answer." On the other hand, Mandarin Chinese does not always connect "left" or "right" with good or bad. Studies show that Chinese speakers often have weaker or less stable left–right emotional links. This suggests that cultural and language background can influence or even override body-based preferences.

This creates a bigger question: Are these spaces–emotional connections mostly from the body (nature), or do culture and language (nurture) play a stronger role? Answering this question helps us understand the limits of embodied cognition. It also has practical importance, because many psychology tools—like association tests or emotion regulation strategies—assume that everyone has the same left–right emotion patterns [3]. If culture and handedness matter, these tools may need to be adapted for different groups.

3. Specific aims

This study will test how cultural priming and handedness work together to shape space–emotion connections. We will compare English monolinguals, whose language links "right = good" and "left = bad," with Chinese monolinguals, whose language does not strongly connect left and right with emotions. By testing both right- and left-handers, we want to see if body preferences are always strong, or if cultural and language settings can change them.

Proposed study: How do cultural environments and handedness modulate the spatial-valence association?

The proposed study address (i.) a critical theoretical gap in the embodied cognition literature regarding the cultural moderation of body-specific effects, and (ii.) an applied question concerning the application of the body-specific hypothesis (BSH) in varying cultural background. First, while the Body-Specificity Hypothesis (BSH) has established a link between motor fluency and spatial-affective mappings, a growing number of studies have demonstrated that the classic body-specific spatial-valence association is not universally stable and appears to be weaker in certain cultural groups, such as native Chinese speakers [4]. The present study will test whether active manipulation of cultural-linguistic context can override or interact with body-specific preferences. Second, we will determine whether implicit association tasks that rely on stable spatial-valence mappings (e.g.,

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some emotion regulation interventions) need to account for individuals' cultural background and handedness.

To address these questions, we will conduct a close adaptation of paradigms used in cultural psychology and embodied cognition. Based on the protocol developed by Casasanto [1] and extended by cultural psychologists, we will prime participants with either a strong spatial-metaphorical linguistic context (in this experiment, we use English) or a weak metaphor context (we use Chinese). We will then administer a bilingual Edinburgh Handedness Inventory (EHI). Consistent with previous studies on the neural correlates of metaphor processing and emotional conflict, we will analyze both spatial-emotion matching practice and spatial-emotional reference to uncover the correlation and causality between spatial position and emotional valence

We will recruit a total of 72 English native speakers and 72 Chinese native speakers, dividing them equally into two groups based on handedness to ensure sensitivity to cultural priming manipulation. We will assess reaction times and accuracy in a spatial emotional matching test, as well as ratings of spatial emotional references, as functions of priming condition (strong vs. weak), handedness (left vs. right), and the congruency of spatial-valence mapping.

4. Method

4.1. Participant

144 healthy adults were assigned to 4 groups by a 2×2 between-subject design of cultural background × handedness, with 36 members per group and 1:1 gender distribution. The strong left-right emotion association group consisted of native English monolingual speakers, whose language cognition follows English's implication of "right (good) and left (bad)". The weak association group consisted of native Chinese monolingual speakers, since Chinese does not have a strong emotion implication for "left" or "right". Handedness screening by Edinburgh Handedness Inventory (EHI) resulted in right-handedness if the participant had an EHI score >70, left handedness if <30, and mixed handedness if between 30 and 70 were excluded at this stage. Participants were between the ages of 18 and 30, had a high school diploma level of education, normal neurological, mental, and vision status, and had no background of spatial-emotional experimentation histories. Post-experimental payment was 20 RMB to the Chinese participant and 5 USD to the English participant [5].

4.2. Design

The present experiment adopted a 2×2 between-subject design that comprised two levels of cultural background (strong left-right emotional association versus weak left-right emotional association) and two levels of handedness (right- versus left-handed) to explore the interacting roles of cultural background and handedness on mental associations of spatial-emotions. Three indicators served as the dependent variables; that is, the reaction time (RT) of the spatial-emotional matching task, which reflects the time interval between the presentation of the valence of the emotion stimuli and the termination of valence judgment by the participant and thus reflects the effectiveness of the process of the emotion stimuli of various spatial loci; second, the accuracy (ACC) of the spatial-emotional matching task, which is computed by calculating the proportion of valid valence judgments, which reflects the degree of cognitive consistency of the mental associations of spatial-emotions of the participants; finally, the rating of spatial-emotional preference, where the participant's score of subjective preference is assigned to the same emotion stimuli that were presented at both the right

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and the left spatial loci, and thus quantifies the strength of subjective correlation between these spatial loci and the emotion [5].

The control variables were set as follows: the duration of stimulus presentation was 800ms to prevent insufficient stimulus processing by virtue of very short duration and participant fatigue by virtue of very long duration; the luminance of the screen was 500cd/m² to prevent variable clarity of the visual stimulus; the experiment took place in a non-noisy laboratory where the temperature remained between 22 to 25°C and controlled to prevent external interference; the experimental task was broken down into 4 blocks, and after each block, there was a relaxation period of 1-minute to prevent participant fatigue; the adopted words of emotion of the two cultural groups were matched on the basis of the words' frequency and length—English words had at least 10 times/million words and 3-5 letters long, respectively, and Chinese words had at least 5 times/million words and 2-3 characters long, respectively—to prevent differential interference of stimulus on the experimental result [5].

4.3. Materials

80 emotional words were selected for each cultural group, including 40 positive words and 40 negative words. English emotional words were sourced from the COCA corpus, and Chinese emotional words were sourced from the BCC corpus. All emotional words were validated through a pre-experiment: each cultural group was evaluated by 20 healthy adults who did not participate in the formal experiment, and the evaluation included two dimensions of valence and familiarity. The valence was rated on a 1-7 scale (1 represents extremely negative and 7 represents extremely positive) and familiarity on a 1-5 scale (1 represents extremely unfamiliar and 5 represents extremely familiar). Finally, words meeting the following criteria were retained: positive words with an average valence of no less than 5.5, negative words with an average valence of no more than 2.5, and all words with a familiarity of no less than 4. Examples of the selected words include “happy” and “sad” for English, and “开心” and “悲伤” for Chinese. For spatial presentation, a 15.6-inch monitor was used with a resolution of 1920×1080 and a refresh rate of 60Hz to ensure stable and clear display of stimuli. A fixation pointed with a diameter of 0.5cm was set at the center of the screen, and the left and right sides of the screen served as emotional word presentation areas. The left presentation area corresponded to a visual angle of -15° and the right to +15°, and the distance from both areas to the central fixation point was equal to avoid interference from physical differences in spatial positions. Stimulus presentation and data recording were implemented.

The handedness was also measured by the Chinese-English bilingual version of the Edinburgh Handedness Inventory (EHI). The version had high validity and reliability, with a Cronbach's α coefficient of 0.89, and included 10 daily activities such as "writing" and "use of chopsticks." Participants indicated the preference of the options "always left," "usually left," "either," "usually right," or "always right" corresponding to the participant's regular practice, and the terminal handedness score was obtained by taking the sum of the scores of all items.

The spatial-emotional preference rating scale comprised 10 stimulus pairs of pictures. Both pictures of the same feeling were presented in each pair, one on the left screen and the other on the right screen. Only the spatial arrangement of the two screenshots of each pair of pictures differed, and the background, text size and text color of the two screenshots were identical. Participants were given a score of 1-5, where 1 meant strong dislike and 5 meant strong like, to offer an index of the subjective spatial-emotional preferences of the participants [5].

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4.4. Procedure

The 40-minute test was conducted inside the climate- and sound-attenuating acoustics test room. Initially, the 5-minute handedness screener was administered: researchers completed the bilingual Edinburgh Handedness Inventory (EHI), while the on-site experimenter verified the obtained scores. Participants deemed eligible (>70 right-handed; <30 left-handed) proceeded to the formal experiment, whereas individuals identified as mixed-handers, falling between 30 and 70, were excluded due to their mixed-handedness classification. Second, the 30-minute matching of spatial-emotions task was carried out. Participants were seated 70cm away from the display screen, and the heads were stabilized on a chinrest so that the viewing angle could be the same throughout the task. Then, the procedure of the task was explained by the experimenter to the participant: positive/negative emotion words would be randomly appeared on the left/right of the display screen, and the participant had to decide the valence of the words displayed and press the corresponding key on the keyboard according to the words shown on the display screen. In order to avoid the interference caused by the difference between the participant's keys-pressing habit, a balanced scheme of key-mapping was used—half of the participant used the "F" key corresponding to positive valence and the "J" key corresponding to negative valence, and the remaining half of the participant used the opposite scheme of key-mapping (the "F" key corresponding to negative valence and the "J" key corresponding to positive valence). Before the formal experiment, a practice procedure was carried out by which 10 practice words not used by the formal experiment were displayed. If the participant's percentage of accuracy of the practice procedure were lower than 80%, the experimenter re-clarified the procedure of task and added 5 more practice trials until the participant's percentage of accuracy reached 80% and above, ensuring the participant could well understand the requirements of the procedure of task. The formal experiment consisted of 160 trials, which were composed of 40 positive words shown twice at two different spatial locations (left, right) and 40 negative words shown twice at two different spatial locations (left, right), where all the trials were randomly shown to avoid sequence interference. The sequence of each trial was consistent: first, the central fixation point was presented for 500ms to guide participants' attention to the screen center; then, the emotional word was presented at the left or right position for 800ms; finally, participants pressed the corresponding key to respond, and the software automatically recorded the reaction time and accuracy of each trial. To prevent participant fatigue from affecting task performance, the formal experiment was divided into 4 blocks, with 40 trials in each block, and a 1-minute rest period was given after each block for participants to adjust their state. Third, a 5-minute spatial-emotional preference rating was conducted immediately: 10 image pairs were presented sequentially, and participants rated left/right stimuli based on subjective preference (1–5 scale, no time limit). The experimenter manually recorded results. Lastly, post-experiment procedure: compensation was handed out (20 RMB for Chinese speakers, 5 USD for English speakers), the aim of the experiment (investigating cultural/handedness effects on spatial-emotional associations) was explained, and questions regarding discomfort (e.g., eye fatigue) were asked and feedback noted. The experiment ended after checking for no objection, and the test-takers were escorted out of the premises.

4.5. Predictions

According to the classical BSH, the right-handed in English native group will show significant Spatial-Affective Valence Congruence Effect, which means that they will react to the positive words in right side and the negative words in left side faster and more accurately than the left-handed in the

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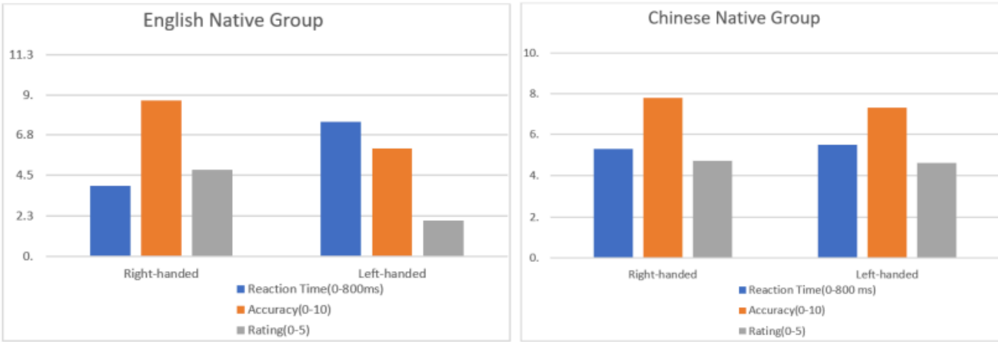
same group, and the right-handed will have stronger subjective correlation between these spatial loci and the emotion than the left-handed in the rating test (fig. 1a). For those participants in Chinese native group, the two groups will present similar results in both reaction time and accuracy. The rating of spatial-emotional preference will exhibit a high degree of similarity (fig. 1b). We can further predict one possible Culture Coverage Effect: when the priming materials are sufficiently powerful, the behavioral patterns of all participants may converge toward the cultural pattern implied by the priming, rather than their body-specific patterns.



(a) (b)

Figure 1. Predictions of the proposed study. (a): Predictions that follow the body-specific hypothesis. (b): Predictions that follow observation in native Chinese speaker [4]

5. Implications and further studies

If the result of the proposed study supports the classical BSH (fig. 1a), this outcome would ensure the absoluteness of body-specific experience, which means that the body-specific experience would have stronger influence on cognition than cultural or language environment. Furthermore, this outcome can be considered as evidence to the natural endowment.

Alternatively, if the result supports the observation from Sheng [4] (fig. 1b), this outcome would enhance the importance of cultural and language environment in affecting cognition, which means that the cultural background may have a stronger influence than body-specific experience. Furthermore, this outcome can be considered as evidence to the nurtural endowment.

One important caveat in interpreting the predicted result: The proposed study will test skillful mmonolingual participants as the first step towards the connection between cultural environment and spatial-valence association. Further studies in binlingualists would need to be tested in order to increase the reliability of the result.

6. Conclusion

This study examines how cultural-linguistic background and handedness jointly influence spatial-emotional associations, contributing to the nature-nurture debate in embodied cognition. These findings demonstrate that while body-specific motor fluency (as predicted by the Body-Specificity Hypothesis) shapes spatial-valence mappings in English speakers, cultural-linguistic context significantly moderates these effects, which is seen in the attenuated patterns among Chinese speakers. This indicates that spatial-affective links are not universally fixed, but are dynamically shaped by the interaction of bodily experience and cultural metaphor systems.

The core contributions of this research lie in its cross-cultural comparative design and its explicit test of cultural priming on body-specific preferences. It underscores the necessity of considering

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cultural and individual difference in psychological paradigms that assume universal spatial-emotional mappings. Future research is expected to extend these investigations to bilingual populations and to explore longitudinal or training-based designs to further disentangle causal influences. Ultimately, this paper advances a more integrated view of embodied cognition—one that acknowledges both the bodily foundations of thought and the profound shaping role of culture.

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