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Original Article

Emotional Valence and Body Representation: An Experiment on Embodied Cognition

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Abstract

Background and Objective: In line with Lakoff's theory of embodied cognition, several studies in the field of emotional processing have demonstrated that positive and negative valence is represented based on spatial and bodily characteristics. The present study aimed to investigate the implicit link between body parts and the emotional valence of Persian words.

Materials and Methods: The participants included 33 right-handed undergraduate students in the field of psychology who were selected via the convenience sampling method. A priming task with emotional negative and positive words (prime) was used, and the participants had to recognize the leftness or rightness of hand stimuli (target). Reaction times were recorded for target stimuli. The data were analyzed in SPSS software (version 24) using repeated-measures ANOVA.

Results: The obtained results pointed to the implicit association of positive and negative words with bodily features (right hand and left hand).

Conclusions: The findings of the current study are finally discussed within theories of embodied cognition, as well as hemispheric and language processing, for emotional stimuli.

Keywords: Embodied cognition, Emotions, Priming, Reaction time

Background

Recent behavioral experiments which have investigated the representation of abstract concepts, including time and number, have linked these concepts to spatial representations. For example, Boroditsky (2000) concluded that an abstract representation, such as time, is affected by concrete spatial mapping [1] (the concepts related to future events are represented on the right side of the space, while those related to past events are represented on the left side of the space). The results of this experiment indicated that dimensions of time and space have inter-related cognitive structures. Moreover, Dehaene et al. (1993) pointed to a similar relationship between numerical and spatial processing [2]. This association which is known as the Spatial Numerical Association of Response Codes (SNARC) effect is well-documented in behavioral and electro-physical studies [3-5]. According to the SNARC effect, small numbers, such as 1 and 2, are associated with the left space, while large numbers, such as 8 and 9, are linked to the right space [2].

The association between space and other cognitive phenomena has recently attracted the attention of numerous researchers. In terms of metaphorical knowledge of the language, Lakoff (1999, 2008) has suggested that positive and negative emotional valence are also linked to spatial metaphors (e.g. "pride" and "happiness" are represented on the upper side of space) (6-8). In a similar vein, multiple studies [9, 10] have demonstrated that mental metaphors of spatial representations our perceptions of emotional concepts. As an example, Casasanto and Dijkstra (2009) have suggested that motor actions affect how participants effectively retrieve emotional memories. In their study, participants were prompted to verbally recall their autobiographical memories with positive and negative valence while doing upward and downward motor actions. The results have indicated that the retrieval of memories was faster when the direction of motor actions was congruent with positive and negative valence (upward for positive and downward for negative emotions) [11].

In another study, participants evaluated emotional words represented on a computer screen, and the results illustrated that positive words were evaluated faster when they were presented on top, whereas the evaluation of negative words was carried out faster when they were presented on the bottom [12]. Several studies reported similar findings and suggested that emotional valence is affected by vertical [13-18] and horizontal spatial positions [19-21]. Furthermore, in different linguistic and cultural traditions, positive valence is associated with right, while negative valence is linked to the left side of the space. For instance, in Islamic culture, it is recommended that negative actions (entering dirty places) be performed with the left foot and positive actions (entering the mosque) be carried out with the right foot. Moreover, in accordance with several Islamic narrations, the two angels who write the good and bad deeds of human beings are on the right and left shoulders, respectively.

In accordance with the embodied cognition approach in neuroscience, the contents of the mind highly depend on physical and embodied characteristics. As an example, most people are more interested in what they do physically with their bodies. In the same context, Oppenheimer (2008) indicated that skilled typists prefer the letters of the alphabet they have dealt with more than the rest of the letters [22]. In another study, Casasanto and Jasmin (2010) concluded that right-handed leaders in politics use their right hand when using positive words [20]. This association between space and emotional valence has also been confirmed by facial and auditory stimuli. For instance, compared to negative faces, faces with positive emotional valence are detected more quickly on the right side [23]; moreover, positive and negative sounds affect the detection of stimuli in vertical positions (up and down) [15]. In one study, participants viewed drawings of space creatures on the right and left of the screen and evaluated their personality traits. On average, right-handed people rated drawings on the right side as smarter, happier, and more attractive, as compared to the drawings which were presented on the left side [19].

In general, previous studies have pointed out that positive and negative emotional valence are functionally correlated with left and right spatial positions. The implementation of similar studies in different cultures is an issue that feeds the research literature in this field. The present study aimed to investigate embodied representation of valence as measured implicitly in a word priming task. The priming method is a paradigm in cognitive neuroscience which investigates implicit conceptual activation and its probable impact on consequent behavior [24-26]. As an example, Bargh, Chen, and Burrows (1996) presented happy and sad images in a priming task and demonstrated that these unconscious emotions, which are practically neutral and meaningless, affect the choice of Chinese writings, [27]. Moreover, word priming with aggressive emotional valence affects first impressions about other people [28, 29].

In compliance with the brief review presented here, the influence of positive and negative prime words was investigated in a hand recognition task. To this end, participants were asked to perform the hand recognition task (Is the target stimulus right or left hand?) for left and right-hand stimuli. Prior to the presentation of targets, prime words (positive and negative) were displayed to the participants. It was expected that positive and negative word stimuli would affect the reaction time for the recognition of left and right-hand stimuli. Therefore, according to this hypothesis, we expected that the participants will recognize the right hand faster when the prime was a positive word and vice versa.

Objectives

The present study aimed to investigate the implicit link between body parts and the emotional valence of Persian words.

Materials and Methods

Participants

A total of 33 right-handed [30] female students in the field of psychology were selected via convenience sampling and participated in the experiment. None of the participants knew about the purpose and hypothesis of the experiment prior to implementation. The exclusion criteria entailed a history of the problematic prenatal or neonatal period, head injury with cerebral symptoms, a history of central nervous system diseases, convulsions or a history of convulsive disorders, spike-wave activity in electroencephalogram, sensorimotor deficits, attention difficulties, and/or other behavioral problems.

The study protocol was approved by the local ethics committee. Participants received detailed information about the study protocol prior to the completion of the informed consent. All of the subjects agreed to participate in the study, signed written consent forms, and were compensated for participation. At the end of the experiment, participants were asked about their guesses regarding the purpose of the experiment. Finally, five individuals who had obtained a preliminary

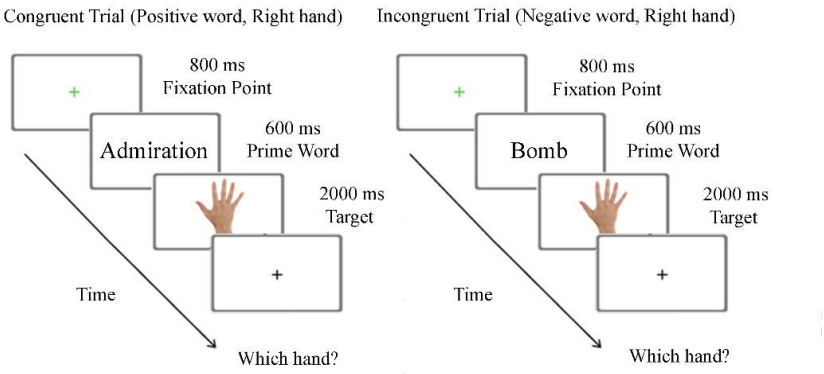

Figure 1. Schematic representation of the priming task. In both conditions, a word with positive and negative valence is presented. In congruent trials, the word is consistent with hand stimuli (e.g. admiration and right hand)

hypothesis were excluded from the final analysis, and a total of 28 data (Mean age=23.4, SD=2.38) were analyzed.

Task and stimuli

Participants performed the task in a quiet room in front of a 15.6-inch monitor at a distance of 60 cm. For the presentation of word stimuli with emotional valence, a normative list for Persian words was used [31]. The normative list included 10 words with positive valence (arousal>3; pleasantness>4) and 10 words with negative valence (arousal>3; pleasantness<2) (Appendix 1). In terms of word length, positive (M=4.5, SD=.84) and negative (M=4.3, SD=.94) words did not differ significantly (t= -0.452, P=0.662). Before the experiment, participants were told that the words had nothing to do with their main task. The experimental task was presented to the participants by the DMDX software [32]. We asked participants to identify the target stimuli, namely the right or left hand, and press the right shift key if the right hand was recognized and the left shift key if the left hand was recognized. In each trial, a fixation point was presented for 800 ms, prime stimuli (positive and negative words) were presented for 600 ms, and the target stimuli (left or right hand) were presented for 2000 ms. To increase the effects of words on participants' responses, each word was presented four times before the target stimuli (each word appeared a total of 8 times). Accordingly, each participant had to respond to a total of 160 trials. Participants were required to recognize the right or left hand as soon as possible and press the respective keys (right and left shift). Figure 1 depicts an example of congruent and incongruent trials of the experimental paradigm.

Results

Statistical analysis was carried out on the reaction time (RT) differences in two different conditions (congruent vs incongruent). In this study, it was hypothesized that when the emotional valence of words (positive vs negative) is congruent with hand (right vs left), the RTs of the participants might be decreased. A 2x2 repeated ANOVA method was used to analyze the data in which the target stimuli (right and left hand) and emotional valence (positive and negative) were regarded as within-subject factors, and the RTs were considered the dependent variable. A p-value less than 0.05 was considered statistically significant. The results of descriptive findings are presented in Table 1.

The results of the Kolmogorov-Smirnov test illustrated that the distribution of scores in the groups was normal (P>0.05). The main effect of hand (F (1, 27) =.294; P=.592) and emotional valence was not significant (F (1, 27)=. 29; P=.866). Nonetheless, regarding the main hypothesis of the research, the interactive effect of "Emotional Valence x Hand" yielded significant results (F (1, 27)=8.682; P=.007). Accordingly, when positive primes were presented before right-hand stimuli, participants' RTs were faster, in comparison with negative primes (M=567, SD=155 vs M=654, SD=260). In addition, when negative primes were presented prior to left-hand targets, the RTs were faster, as compared to positive primes (M=580, SD=180 vs M=673, SD=251).

Figure 2. represents the mean RTs for different task conditions, and the results of 2x2 repeated ANOVA are displayed in Table 2.

Table1. Mean and standard deviation of reaction times for different conditions of the task

	Mean	SD	N
Positive valence right hand	567.0964	155.20145	28
Negative valence right hand	654.0893	260.95393	28
Positive valence left hand	673.1429	251.87368	28
Negative valence left hand	580.2714	180.18456	28

Table 2. Results of 2x2 repeated ANOVA

Source	Type III SSE	df	MS	F	Sig.	ηp2	Observed Power
Hand	7270.766	1	7270.766	.294	.592	.011	.082
Emotion	241.903	1	241.903	.029	.866	.001	.053
Hand * Emotion	226458.12	1	226458.12	8.682	.007	.243	.811

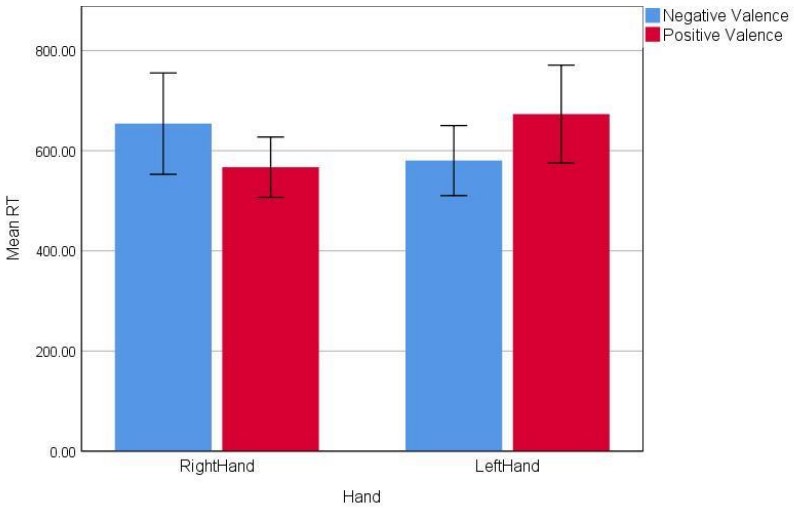

Figure 2. Performance of participants in recognition of left and right hand as reflected in mean reaction time. The reaction times for target stimuli in congruent and incongruent conditions are presented in this graph. Error bars represent 95% CI

Discussion

The present study sought to assess the association of bodily representations and the processing of emotional stimuli with positive and negative valence. Participants were asked to recognize their left or right hand as soon as these stimuli were presented to them. To evaluate the effect of emotional stimuli, normative words with positive and negative valence were used as primes. The results pointed out that the recognition of the right hand was faster when positive primes were provided, while the recognition of the left hand was faster when negative primes were presented.

In cognitive neuroscience, two major theories have been proposed in terms of emotional processing: 1) the right hemisphere hypothesis (RHH) [33] and 2) the valence-specific hypothesis (VSH) [34]. The RHH proposes that emotional processing is lateralized within the right hemisphere, regardless of its valence [35]. The VSH postulates a different view and assumes that the left hemisphere is more responsible for positive stimuli [36]. Regarding the fact that positive emotional words led to faster RTs for right-hand recognition, the intrahemispheric interactions between emotional words and motor components might be in accordance with VSH. On the other hand, based on the approach-withdrawal hypothesis of Davidson et al. (1990), the relationship between positive/negative valence and the right/left side of the body is probably due to the existence of motivational systems that control two types of behaviors (i.e. "approaching" to and "withdrawal" from environmental stimuli) [37, 38].

It has been proposed that approach behaviors are associated with left-sided hemispheric activation (which controls the right side of the body), and withdrawal behaviors are closely related to right-sided hemispheric activation [37]. This hemispheric lateralization is also evident in early studies which revealed that the left hemisphere is more specialized in processing facial stimuli with positive emotional valance [39], while the right hemisphere is more specialized in processing negative facial stimuli [40]. Furthermore, it has been demonstrated that differentiating stimuli with negative valence from neutral ones is facilitated when they are presented in the left visual field and vice versa [41].

The results of the present research are in accordance with clinical data which confirmed the role of hemispheric lateralization in the processing of positive and negative stimuli. As an example, laughter reactions are frequent in epileptic seizures involving the left hemisphere, while in seizures involving the right hemisphere, crying reactions are more common [42]. Given the fact that the bodily features are controlled by the opposite hemisphere (left hemisphere-right hand), the findings of this research are in agreement with previous studies.

A similar right/positive and left/negative relationship has been also observed in cultural and linguistic settings. For instance, in Romanian culture, speakers are prevented from using their left hand alone (20). Moreover, in Ghanaian culture, pointing to others with the left hand is prohibited

[43]. We also know that in Islamic culture, it is recommended that negative actions (entering dirty places) be performed with the left foot and positive actions (entering the mosque) with the right foot. From a linguistic perspective, Persian terms, such as "right bowel" or "right man", have associated positive things with the right space. In a similar vein, the word "right" in French (droite) and German (recht) is closely related to the legal word "right" [19]. The results of the current study should be also explained according to these cultural and linguistic settings. The long-term association between right and positive, as well as left and negative, in cultural conventions might account for implicit links observed in the present study.

In general, the findings of the present research are consistent with those reported by previous studies in the field of embodied cognition, hemispheric processing, and emotional processing language. According to one suggestion, the right-left link in different languages and cultures is a consequence of the relationship of space and emotional valence with bodily representations. In this regard, the majority of people have a dominant hand (mostly the right hand); as a result, it is easier to interact with the environment on the right side of their body [22]. In other words, sensory-motor experiences with the dominant hand cause positive stimuli to be implicitly associated with the right side of the body [19].

Among the notable limitations of the present study, we can refer to the exclusion of left-handed individuals. The association of the right and left hand with space and emotional valence is likely to be affected by differences in the dominant hand. Therefore, comparing right-handed and left-handed participants in this regard might be of interest for future research. In addition, the features of the primed words, such as the frequency of each word in Persian, and the abstractness or concreteness of the words, have not been controlled in the present study, and it is expected that these features will be controlled in future studies. Furthermore, the use of the present task with electrophysiological recordings, such as event-related potential and extracting components, including lateralized readiness potentials, are encouraged.

Conclusions

In the present experimental research, it was revealed that emotional valence is associated with the left and right sides of the body (left and right hand). According to the main hypothesis of the study, the interactive effect of emotional valence and hand recognition yielded significant results. We interpreted the results in light of theories of embodied cognition, as well as hemispheric and language processing, and added to the evidence that emotional stimuli might be linked to bodily representations.

Compliance with ethical guidelines

All procedures performed in the present study involving human participants were in accordance with the ethical standards of the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The central ethical committee of the university and local authorities approved all related procedures.

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None.

Authors' contributions

Saied Sabaghypour: Designed the study. Saied Sabaghypour, Hassan Sabourimoghadam, Mohammad Ali Nazari and Ali Jahan: drafted the manuscript, gathered the data and have done data analysis and revised the manuscript. Hassan Sabourimoghadam, Mohammad Ali Nazari and Ali Jahan: Technical Comments

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Conflicts of Interest

The authors of the present study declare that they have no conflict of interest.

Appendix. Normalized emotional words used in the priming task

Positive valence	Arousal level	Pleasantness level
Hug	3.64	6.10
Sun	3.65	5.24
Marriage	5.15	5.86
Hope	4.82	6.06
Child	4.65	5.57
Kiss	4.82	6.01
Progress	5.13	6.32
Success	5.17	6.30
Admiration	4.62	5.85
Birth	4.93	5.80
Negative valence	**Arousal Level**	**Pleasantness Level**
Evil	5.68	1.86
Execution	6.21	1.57
Bomb	5.99	1.95
Destruction	5.35	1.96
Tumor	5.82	1.62
Corpse	5.80	1.88
Crime	5.96	1.71
Hell	5.93	1.63
Accident	5.84	1.94
Betrayal	5.89	1.52

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