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Peak Experience and High Altitude--Evidence for the Embodiment of Metaphor Theory

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ABSTRACT. *There has been enormous amount of evidence supporting that human not only use metaphorical languages but also think metaphorically. However, there is limited amount of evidence indicating that metaphors are embodied in human brains, which poses a serious challenge to the Embodied Theory. This proposal assumes that when stimuli of source domains and target domains are strongly elicited, the metaphors connecting these two domains will be embodied in the modality-specific areas of human brains. This proposal thereby presents two fMRI experiments studying the overlap in human brains while perceiving peak experience and the information of altitude. If the overlap mainly lies in the modality-specific areas, then the experimental hypothesis is supported which could serve as strong evidence explaining how Embodied Theory operates in terms of ABSTRACT. concepts. If the overlap only exists in amodal areas and therefore the alternative hypothesis is supported, then further research should be carried out to examine the stimuli of these experiments or propose better experimental plans seeking for other evidence.*

KEYWORDS: *Embodied cognition, Metaphor theory, Peak experience, Functional magnetic resonance imaging*

1. Introduction

The past decades have witnessed astonishing development of how languages in human brains make connection with the real world. Being different from the computer model of human brains that was widely accepted several decades ago [1], embodied theory becomes popular now as a new method of explaining human cognition. It is contended that human brain runs “simulation” in modality-specific areas of brains that are closely related to sensory cortex, including visual cortex, motor cortex etc while perceiving and processing specific languages about bodily experience [2]. With the lack of ability to explain the neural mechanisms underlying the process of abstract concepts, which is a serious challenge embodied theory is currently facing [3], Metaphor Theory is therefore proposed, claiming that people apply the pair of source domain, which is generally concrete and perceivable and target domain, which is more abstract, to help understand abstract concepts. There are large amount of evidence supporting that human do think metaphorically, such as the “good is up and bad is down” metaphor people use commonly [4].

However, there is very little experimental neural evidence suggesting that metaphors are embodied in human brains. In other words, it cannot be supported that the metaphorical representations can trigger simulation in modality-specific areas of human brains. There was one experiment done by Quadflieg and colleagues [5] that was supposed to provide strong data supporting that metaphors are embodied. In the experiment, researchers asked participants to perceive three groups of stimuli during the process of functional magnetic resonance imaging (fMRI). They were given the groups of words of high vs low spatial locations, the groups of words of positive vs negative valence and the groups of words of powerful vs maid status. For the data analysis process, the author applied multivoxel pattern analysis (MVPA) as a classifier to be trained to distinguish between the spatial locations of high and low. The results should be, based on the guess that metaphors are embodied, that the trained classifier is able to detect and discern the fMRI images of powerful vs main status and those of positive vs negative valence. But the author found out that the only two regions that overlapped in processing the two groups of words were intraparietal sulcus and the supramarginal gyrus which are known as amodal areas of human brains processing multi-modal information. The information of these two groups of stimuli is also found to be processed in some modality-specific areas as well, which not only falsifies the hypothesis that metaphors are embodied, but also goes against a potential alternative hypothesis that metaphorical concepts are processed in amodal areas of brains.

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We will assume in this paper that the main problem of Quadflieg's and other experiments failing to find neural evidence to support the embodiment of metaphors is that the stimuli utilized are not strong enough. Similar argument has been proposed by other researchers studying Metaphor Theory. Kross and colleagues who focused on the somatosensory representations shared by both social rejection and physical pain deem that the experience of social rejection will only activate the brain regions that are specific for processing physical pain when the stimuli are elicited powerfully enough [6]. Kross actually provides a potential solution to the problem of that all neural experiments of the embodiment of metaphors have, which is to strengthen the power of the stimuli. The participants' own experience of being rejected in a romantic relationship is much stronger than simply reading words on screens.

Therefore, in this paper, we choose the source domain of height and the target domain of peak experience. Personal peak experience, defined as extremely joyful and exciting life moments that come suddenly and intensively [7], is strong enough as a stimulus because it is fairly rare in one's life and it is metaphorically related to height or altitude as Maslow placed self-actualization, meaning to achieve and gain approval, at the very top of his hierarchy of human needs [8]. We thereby hypothesize that individual's perception of peak experience is embodied in the modality-specific areas of human brains.

2. Methods

2.1 Participants

50 participants, with ages between 25 and 30 years, are planned to be recruited for this study. These participants should have normal vision or correction, normal hearing, no neurological or psychiatric history, and did not take any medication. All participants will sign the informed consent and did not know the purpose of the study before the experiment.

2.2 Experimental Task

Participants will complete two tasks, both inside the fMRI scanner. Task one will involve a height experience with a VR device. Specifically, participants will watch a short clip of animation in the first-person view, either looking downward on a mountain top (High condition) or looking up at a building while standing on the ground (Low condition). Another task is the peak experience task, in which psychologists tell stories to help participants recall and think about peak experiences. Participants will complete both experiments in the fMRI scanner, and the pattern of activation in their brains will be compared under two conditions to see if a similar pattern of activation in some modality-specific areas of the brain can be found.

2.3 Stimulus Materials

First, in order to help participants fully recall their peak experience, a confederate will collect the participants' peak experience stories in advance (without revealing the purpose of the experiment), which will be specific and vivid, including specific details such as time, place and events. These peak experiences will include an athlete who breaks records to win a championship in a sport event, a doctor who saves the life of a critically-ill patient through tireless efforts, a wedding to a loved one, and a child who calls himself "daddy" for the first time.

2.4 Fmri Paradigm

We plan to ask 1,000 participants to experience "high" and "low" heights through VR and obtain FMRI images of participants at different heights through fMRI. Using the obtained image data, we set up a classifier to assist the judgment, input the FMRI image data under 1000 different height experiences, help the classifier understand the corresponding relationship between the data and "high"/" low ", and finally achieve the purpose that the classifier can automatically identify which height experience the image data corresponds to.

In the formal experiment, the psychologists will tell the participants their own stories of peak experiences in detail and vividly, trying to stimulate the participants to think about the peak experience, gain relevant feelings, and simulate the psychological activities in the peak state of real experience. The fMRI image data of the participants when they are listening to and feeling the peak experience will be obtained through fMRI. We plan to use machine learning to train a classifier that can differentiate between brain activations under high/low VR

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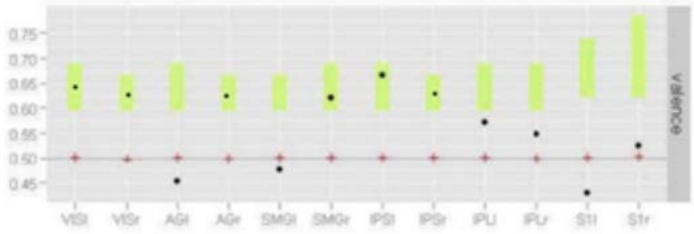
conditions. We will then use this classifier to read participants' fMRI data from the second task. Finally, we will assess overlapping regions in the brain when the classifier makes a correct classification.

3. Results

Since we have not done the experiment, all the following are hypothetical scenarios where each of the three hypotheses is supported. Hypothesis one stated that the neural cognitive representation of peak experiences includes some mortality-specific areas of the brain, such as visual cortex and the auditory cortex. If this hypothesis is correct, the classifier trained in the VR experiment, where the participants experience going up the mountain and going down to a valley using VR in the fMRI scanner, would be able to successfully discriminate between high-point experience and low-point experience. Specifically, under hypothesis one, the areas of the brain where the classifier can succeed in discriminating would include some modality-specific areas of the brain. It is implausible that only the modality-specific areas would be responding, so the classifier will work for both the modality-specific areas and modality-nonspecific areas of the brain (shown in fig.1.). This will suggest that people's mental metaphor of peak experience is embodied in mortality-specific cortexes. This will provide evidence for the Metaphor Theory in that the source domain, perception of going up and going down, can activate the target domain, the idea of high-point (positive) life experience and low-point (negative) life experience.

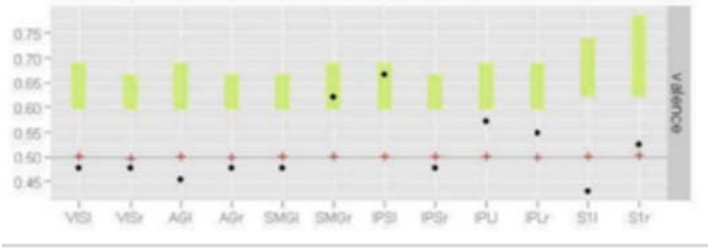
Under hypothesis two, which stated that the neural cognitive representation of peak experience would only be shown in modality-nonspecific areas of the brain, such as the left-temporal cortex. If this hypothesis is correct, the classifier would still be able to discriminate high-point and low-point experience, but it will only work in modality-nonspecific areas of the brain (shown in fig.2.). Under both hypotheses one and two, which suggests that there is a mental metaphor that "high-point" is high and "low-point" is low, there will be areas in the brain where the discrimination can be possible. So the classifier will succeed in picking out the high-point and the low-point experiences. The only difference is that the classifier will succeed in both mortality-specific and modality-nonspecific areas of the brain under hypothesis one but only in modality-nonspecific areas under hypothesis two. Only hypothesis one will be able to give evidence for the Metaphor Theory since mortality-specify areas are activated during the process.

Under the null hypothesis, the classifier train in former VR experiment will complete fail to discriminate between high-point experience with low-point experiences (shown in fig.3.). This suggests that there is no evidence that a mental metaphor exists linking positive (high-point) life experience with high altitude and negative (low-point) life experience with low altitude.



(Quadfleig et al ,2011,JoCN)

Fig.1 The Classifier Will Work for Both the Modality-Specific Areas and Modality-Nonspecific Areas of the Brain



(Quadfleig et al ,2011,JoCN)

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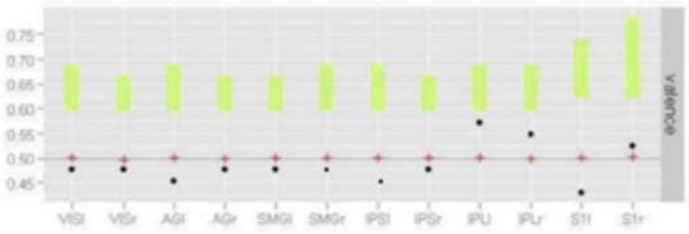
Fig.2 The Classifier Will Only Work in Modality-Nonspecific Areas of the Brain



(Quadfleig et al ,2011,JoCN)

Fig.3 The Classifier Train in Former VR Experiment Will Complete Fail to Discriminate between High-Point Experience with Low-Point Experiences

4. Discussion

In our previous study, we have learned that we are able to use FMRI to investigate whether there is an overlap between physical pain and interpersonal pain and some researches also studied about the neural overlap between physical pain and social rejection in a deeper way . As these studies came up with the result that both types of experiences led to overlapping increases in activity in affective pain regions, we have confirmed that social rejection and physical pain are similar not only in that they are both distressing, they share a common representation in somatosensory brain systems as well. When it comes to our experiment, we asked our participants to go through two tasks. And the performances of the participants between the two tasks is striking for us to compare. Comparing the visual stimulated experience with the different height through the VR experience, these two experience activate distinct parts of our brain as they are exposed to different stimuli. However, that is just part of our predictions.

4.1 P1 Were Upheld While H1 Supported

When we assume that the people's perceptual experience of being through the peak is embodied in the modality-specific area ,the FMRI activity would activate multi-modal areas in the brain and these experiences appear to show similar activations when the participants are talking about the peak experience and the high altitude through VR .

4.2 P2 Were Upheld While H2 Supported

As we regard the peak experience is processed in the amodal areas, the results of these two tasks result in similar activations in the amodal areas of the brain. However, we lack evidence to prove which hypothesis is right.

Most importantly, mental metaphors are "embodied". And the fMRI activity related to peak experience would activate common regions within networks linked to visual cortex of altitude. Again, As the rejection and physical pain share a common somatosensory representation as well. We are able to indicates that mental metaphors can be expressed. For this experiment, we regard altitude as visual cortex which lead to embodied cognition directly. However, we haven't acknowledged it.

5. Conclusion

This research focuses on the evidence for the embodiment of metaphor theory. Embodiment of metaphors are a proof of the embodiment thesis often focus on metaphors the body as source domain which plays an important role in the study field of psychology. This research do not only discusses about the brain but also include the part of visual cortex and auditory cortex which contribute to the modality-specific areas and modality-nonspecific areas of the brain. However, this study promote the further study of the relationship between altitude as visual cortex and embodied cognition.

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