Expertise Modulates the Perception of Pain in Others

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Introduction

Perceiving the pain of others activates a large part of the pain matrix in the observer [1]. Since this shared neural representation may lead to empathy or personal distress [2-3], regulatory mechanisms must operate in people who inflict painful procedures in their practice with patient populations in order to prevent their distress from impairing their ability to be of assistance. In this functional MRI study, physicians who practice acupuncture were compared to naïve participants while observing animated visual stimuli depicting needles being inserted into different body parts including the mouth region, hands and feet. Results indicated that different brain network was activated between control and expert groups.

Methods

Twenty-eight (14 females) right-handed participants were enrolled in the study (Mean age 35; SD 8 yrs). One group (N = 14; 7 females) was composed of physicians with experience in acupuncture for at least two years (Expert group). The other group, matched for age and educational level (N = 14; 7 females) was composed of participants with no acupuncture experience (Control group). Before the scanning, participants filled out a series of dispositional measures including the situational pain questionnaire, the emotional contagion scale, the interpersonal reactivity index, and the empathy quotient. A total of 120 3-sec dynamic visual stimuli (120 GIF-files) were shown during functional MRI (fMRI) scanning. These stimuli consisted of pictures of different body parts. In half of the stimuli, the body parts were touched by a Q-tip (non-painful situations), and in the other half, pricked by an acupuncture needle (painful situations). fMRI scanning consisted of three runs (mouth region, foot region, hand region) in a randomized and counterbalanced block design. The visual stimuli were shown in 30-s blocks, with 30-s fixation periods between blocks. Each run included three repetitions of the situations with body parts being either touched by Q-tip or pricked by a needle. After scanning, participants were asked to rate pain intensity and pain unpleasantness with the same visual dynamic situations that they had seen in the scanner using a computerized visual-analogical scale (VAS) with no pain/extreme pain and no effect/extreme unpleasantness as target words. All fMRI analysis was performed by using SPM2 (Wellcome Department of Cognitive Neurology, Institute of Neurology, London, UK) and in-house program.

Results

Behavior measurement:

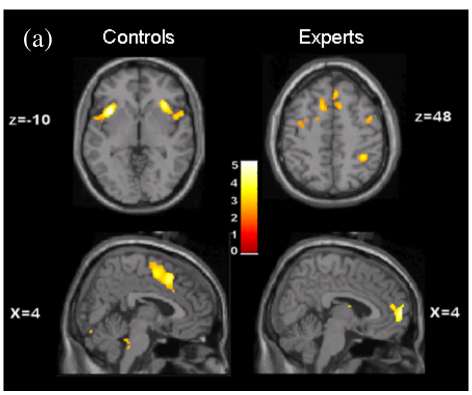
The analyses of the dispositional measures revealed no difference between the two groups. The VAS ratings indicated significant differences between the two groups separately for pain intensity [$P < 0.001$] and unpleasantness [$P < 0.001$], such that Control participants reported significantly higher pain intensity and unpleasantness ratings than Expert participants. Both groups had similar ratings across watching different body parts [pain intensity: $P > 0.05$; unpleasantness: $P > 0.05$].

fMRI activation pattern:

An interaction analysis was conducted to intesvigate the differential activity related to the effect of expertise. This interaction demonstrated that the Controls had stronger bilateral activation in the insula and anterior cingulate cortex (ACC) than the Experts. The reverse comparison, however, showed that the Experts had stronger activation in the superior frontal gyrus and medial prefrontal cortex (mPFC) than the Controls (Figure 1a).

Correlation analysis between BOLD signal and behavior measurement:

The random-effect correlation analysis between the brain BOLD response and VAS ratings in the two groups disclosed that ratings of pain intensity correlated positively with anterior insula and ACC, but negatively with mPFC and superior frontal gyrus (Figure 1b). For unpleasantness ratings, there was also positive correlation in the activity of insula and ACC but negative correlation in the superior frontal gyrus and mPFC. Thus higher ratings of pain intensity and unpleasantness, which the Controls were more likely to give, were associated with stronger activation in the anterior insula and ACC, but weaker activation in the mPFC.



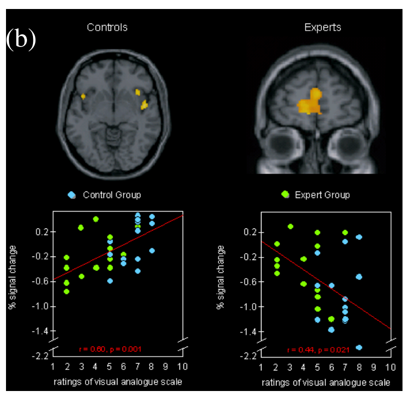


Figure 1a :
Differential neural activations between the Experts and Controls when watching body parts being pricked by an acupuncture needle
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Figure 1b :
Correlations between pain intensity ratings and the hemodynamic responses of all participants when watching the mouth region being pricked by an acupuncture needle. The activation in the insula showed a significant positive correlation with ratings of pain intensity. Activation in the medial prefrontal cortex was negatively correlated with ratings of pain intensity.

Discussions

Our study clearly demonstrated that learned experience and meta-cognition played a role in the way we perceived other people in pain. Activation in the regions underpinning the affective-motivational aspects of pain processing, as detected in the Control group, was suppressed in the Expert group. People who practiced acupuncture knew that such situations could be painful for their patients and have learned throughout their training to “inhibit” the empathy-pain response. This knowledge was important for them to regulate their feelings of unpleasantness generated by the perception of pain in others, and therefore necessary for successful professional practice. However, it should be acknowledged that, because of the low temporal resolution of fMRI-Bold responses, it was not possible to tell when the top-down modulation occurs in the pain matrix. To address this issue, we are replicating this experiment using event-related potential measures with a similar paradigm.

Acknowledgements

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References

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