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Research article

Gender differences in performance for young adults in cognitive tasks under emotional conflict

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ABSTRACT

Previous studies have shown that men and women behave differently on diverse cognitive tasks. However, gender differences in recognizing and memorizing faces when in emotional conflict situations are unknown. Therefore, a face-word Stroop task (emotional conflict) and subsequent memory task were used in the present study to examine gender differences among young adults in an emotional conflict situation. Behavioural data showed that men were better able to recognize faces while in emotional conflict, whereas women performed better at the memorization task. Emotional conflict had different effects on memorization performance between men and women. Women memorized more incongruent faces and men more congruent ones. The results confirm the need for further neural study in this area.

1. Introduction

Cognitive conflict is a task-related conflict, which arises when different processes or features appear and interfere with each other at the same time. Emotional conflict is currently a popular research topic in the field of emotion and cognition, and has developed from studies on cognitive conflict. It refers to the interference of irrelevant emotional stimuli in the current cognitive task. The classical paradigm of emotional conflict is the word-face paradigm. This paradigm involves the viewing of facial expressions with emotional words written on the center of the image of a face (on both sides of the nose), and requires subjects to judge the emotional valence (i.e., intrinsic attractiveness/goodness or averseness/badness) of the face while ignoring the emotional meaning of the word. This paradigm has been widely used in the psychological domain [1–5] as well as among normal subjects [6–8]. Studies have covered from conflict monitoring [9], conflict adaptation [10,11] to the proportion congruency effect [7,12].

However, it is worth noting that the key to emotional conflict lies in the recognition of emotional words and faces. In addition, research on the behavioural, event-related potential (ERP), and functional magnetic resonance imaging (fMRI) results of facial expression processing has indicated that, when encoding emotional visual information, especially the processing of facial expressions, males and females show significant differences in the aspects of emotional information processing. In particular, women have more distinct advantages over men in recognizing non-emotional information. Behavioural studies have investigated gender differences in the rates and reaction times required to recognize basic emotions, revealing that women recognize facial expressions more quickly [13] and more accurately [14] than do men. Males show asymmetrical visual cortical function in decoding facial expressions, while females show more bilateral features [15]. Studies using fMRI technology have also suggested that different neural networks are activated in men compared to women during the processing of happy and sad faces [16–18].

Based on the above results, we have reason to speculate that there are gender differences in human facial recognition and thus in behavioural performance in the word-face paradigm. However, as far as we know, studies using the word-face paradigm have not considered gender differences in the processing of emotional conflict. Therefore, by using a word-face task, the first objective of this study was to determine whether gender differences exist in the processing of emotional conflict.

Conflict control, a crucial part of conflict processing, monitors conflict in perceptual inputs or detects conflict between one's preferred and required responses, and then executes attentional control over this conflicts. In conflict tasks, incongruent trials usually require more conflict control processing (longer response time; RT) to perceive conflict and execute control over the conflict situation when compared to congruent situations.

There has been a great number of researches focusing on the relationship between conflict control and memory [19–21]. Two main theories exist, although they are contradictory. Some scholars believe that target information stemming from an incongruent trial should be recalled with greater accuracy than those stemming from a congruent trial due to conflict-driven attentional enhancement [22]. Other

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Table 1
Descriptive information for subjects(M ± sd).

	male	female	p value
Age(years)	22.778 ± 2.048	22.556 ± 1.878	0.813
Education years	15.222 ± 1.202	15.000 ± 0.500	0.616
IQ[a]	119.6 ± 11.5	118.4 ± 10.6	0.766

[a] Wechsler Adult Intelligence Scale (Chinese version).

scholars, however, assume that the additional control operations required to overcome interference from incongruent distracters might impair the processing and subsequent memory of target stimuli as a result of limited processing resources [23]. Although both of these theories are supported by the literature, few studies have evaluated gender differences. Indeed, men and women show differences in performance on various memory tasks. Men have an advantage in visual-spatial working memory, whereas women show superiority in memory related to faces [24–26]. There is reason to believe that gender differences in memory exist under situations of emotional conflict control. In light of this, the second objective of this study was to investigate the effects of emotional conflict on the recognition of emotion in faces, and to determine whether this ability differs between males and females.

2. Methods

2.1. Participants

Study participants consisted of 30 healthy students (15 males, 15 females) recruited from Southern Medical University in China (see Table 1). In order to eliminate the effect of the menstrual cycle [24], we selected female participants who were at different menstrual phases at the time of the study, with 7 in the follicular phase (the first day of menstruation to ovulation, normally days 1–14), and 8 in the luteal phase (the day after ovulation to the day just before menstruation, normally days 15–28). All participants were right-handed, had normal or corrected-to-normal vision, and had no history of neurological or psychiatric illness. All participants provided written informed consent. The study was approved by the Ethical Committee of the affiliated Zhujang Hospital of Southern Medical University, China.

2.2. Experimental procedure

Participants performed two sets of formal experiments, relating to the recognition and memorization of emotion in faces selected from the native Chinese Facial Affective Picture System [27]. The arousal values evoked by the positive and negative faces in Experiment 1 and 2 were not significantly different (see Table 2). Task presentation and behavioural response recordings were performed using E-Prime 2.0 software.

To familiarize themselves with the experiments, each participant was asked to complete practice trials (24 trials each for Experiments 1 and 2) before completing the formal experiments. All participants completed at least one run, and the training was terminated when they reported more than 90% accuracy or completed two runs, whichever came first. Faces used in practice experiments were not shown during formal experiments.

Table 2
Arousal values[a] in experiment 1 and 2(M ± sd).

		sad	happy	p value
Experiment 1	male	5.322 ± 0.745	5.314 ± 0.846	0.662
	female	5.469 ± 0.667	5.409 ± 0.567	0.386
	total	5.452 ± 0.809	5.341 ± 0.941	0.536
Experiment 2	male	5.395 ± 0.697	5.470 ± 0.811	0.151
	female	5.518 ± 0.882	5.370 ± 0.811	0.368
	total	5.493 ± 0.737	5.289 ± 0.688	0.063

[a] The arousal values for the corresponding pictures were collected from the native Chinese Facial Affective Picture System(CFAPS) [24], which had already been measured.

2.2.1. Experiment 1

In Experiment 1, we used an emotional face-word Stroop task to elicit emotional conflict. Emotional faces (either happy or sad) were placed in the center of a screen, with a red Chinese word (either "yukuai", which means "happy", or "beishang", which means "sad") superimposed on the face at approximately the location of the nose. The valence of the emotional word was either congruent or incongruent with the valence of the emotional face. The experiment task consisted of 2 × 2 × 2 conditions that varied according to gender (male or female), emotional congruency (congruent or incongruent), and valence of the facial emotion (positive or negative). The study employed an event-related design and consisted of 96 trials, with an equal proportion of each condition. In other words, gender, congruency, and facial emotion were balanced, with an equal number of faces for each combination (gender × congruency × emotion). Stimuli were presented for 1000 ms, with a varying inter-stimulus interval of 3000–5000 ms during which central fixation "+" was shown (Fig. 1A). Stimuli were presented in a pseudo-random order and no faces were repeated. Participants were asked to judge the valence of the emotional faces as quickly and correctly as possible by pressing the "F" key (on a computer keyboard) for happy and the "J" for sad.

2.2.2. Experiment 2

In experiment 2, we used an incidental facial memorization test. Sixty-four of the previously seen faces and 64 novel faces were included. The gender radio of both familiar and novel faces was equally balanced (50%), as was the former trial category of familiar faces (including both congruent and incongruent face; accounting for 25% each). Stimuli were presented for up to 3000 ms and disappeared when participants pressed the corresponding keys. The inter-stimulus interval varied from 2000 to 4000 ms, with a central fixation "+" shown (Fig. 1B). Participants were asked to indicate whether they remembered the current face by pressing key with specific finger of the hand: left middle finger pressing "D" for "definitely old"; left forefinger pressing "F" for "probably old"; right forefinger pressing "J" for "probably new"; right middle finger pressing "K" for "definitely new". These four options

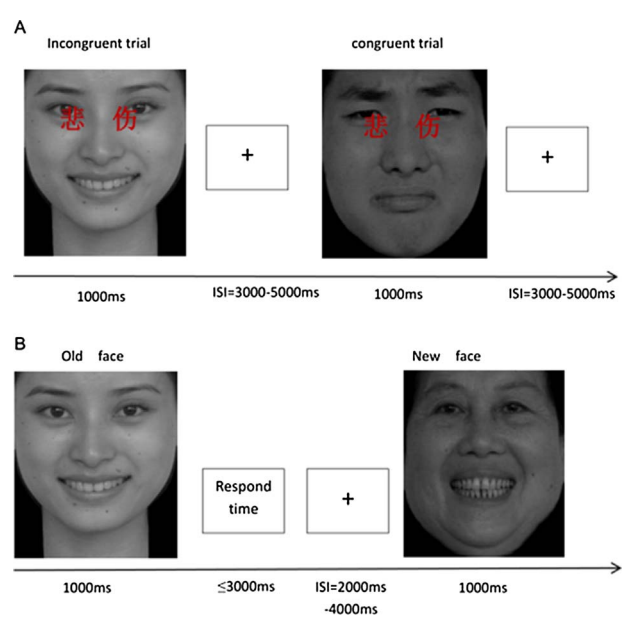

Fig. 1. Structure of experiment 1(A) and experiment 2(B).