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Research paper

The effect of low versus high approach-motivated positive affect on the balance between maintenance and flexibility

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HIGHLIGHTS

- We examined the effect of positive affect with different motivational intensities on the balance between maintenance and flexibility.
- Low approach-motivated positive affect attenuated maintenance and increased flexibility.
- High approach-motivated positive affect promoted maintenance and decreased flexibility.

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ABSTRACT

Successful goal-directed behavior in a constantly changing environment requires a balance between maintenance and flexibility. Although some studies have found that positive affect influences this balance differently than neutral affect, one recent study found that motivational intensity of positive affective states influences this balance in a cognitive set-shifting paradigm. However, working memory updating and set shifting are interrelated but distinct components of cognitive control. The present study examined the effect of low versus high approach-motivated positive affect on the balance between maintenance and flexibility in working memory. A simple cuing paradigm (the AX Continuous Performance Task) was employed, and neutral affect and high and low approach-motivated positive affect were induced using affective pictures. The results revealed that, relative to neutral affect, low approach-motivated positive affect attenuated maintenance and increased flexibility, whereas high approach-motivated positive affect promoted maintenance and decreased flexibility. These findings offer further evidence that the effects of positive affect on cognitive control are modulated by approach motivational intensity.

1. Introduction

Successful goal-directed behavior in a constantly changing environment requires a dynamic balance between maintenance and flexibility. Maintenance refers to stably maintaining the current goal and shutting out task-irrelevant stimuli or competing response tendencies. Flexibility is regarded as flexibly switching between goals and updating working memory whenever significant changes occur in the environment or internal state. Maintenance that is too rigid results in a state of perseveration, whereas over-regulation of flexibility incurs a cost in terms of increased distractibility. Prior experimental research has suggested that positive affect shifts the maintenance-flexibility balance towards increased flexibility [1–3]. However, these studies have mainly focused on low approach-motivated positive affect rather than high approach-motivated positive affect.

According to the motivational dimension model of affect recently proposed by Gable and Harmon-Jones, positive affects vary in motivational intensity, which refers to the strength of urge to move toward a stimulus [4,5]. High approach-motivated positive affect often occurs in pursuit of a goal, and low approach- motivated positive affect occurs after a goal has been achieved or when there is no goal. Low versus high approach-motivated positive affect may have different influences on cognitive processing. Indeed, a growing number of studies have demonstrated that low approach-motivated positive affect broadens attentional and cognitive scope, whereas high approach-motivated positive affect narrows attentional and cognitive scope, and shortens time perception to assist goal-directed behavior [6–10].

Given the motivational dimension model of affect and relevant research, it seems plausible that the cognitive broadening caused by low approach-motivated positive affect may increase cognitive flexibility, because low approach-motivated positive affect suggests a stable and comfortable environment and thus promotes

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openness to new opportunities and goals. In contrast, the cognitive narrowing caused by high approach-motivated positive affect may facilitate goal performance and maintenance, because organisms shut out irrelevant stimuli, perceptions and cognitions to approach toward a desired goal. Some studies support for this hypothesis [11,12]. Price and Harmon-Jones [11] found that high versus low approach-motivated positive affect has different influences on cognitive categorization processes that have been associated with cognitive flexibility. That is, high approach-motivated positive affect narrowed categorization and thus decreased cognitive broadening and flexibility, whereas low approach-motivated positive affect broadened categorization and thus increased cognitive broadening and flexibility. In addition, Hart and Gable [12] showed that high approach-motivated positive affect facilitated successful pursuit of a primed goal state to a greater degree than low approach-motivated positive affect.

Maintenance and flexibility are supposed to impose antagonistic processing modes. Thus, low approach-motivated positive affect, while enhancing cognitive flexibility, should weaken maintenance. In contrast, high approach-motivated positive affect, while decreasing cognitive flexibility, should enhance maintenance. To our knowledge, only one study has demonstrated this assumption [13]. Liu and Wang [13] employed the cognitive set-switching paradigm and used affective pictures to manipulate positive affect. Results revealed that low approach-motivated positive affect decreased switch costs in the perseveration condition and increased switch cost in the distraction condition, whereas high approach-motivated positive affect increased switch cost in the perseveration condition and decreased switch cost in the distraction condition. This pattern indicated that low approach-motivated positive affect increased cognitive flexibility at the cost of higher distractibility, whereas high approach-motivated positive affect promoted perseverance but decreased distractibility. Liu and Wang [13] concluded that their findings were generally consistent with the motivational dimension model of affect. However, the theoretical and experimental literature suggests that working memory updating and set shifting are interrelated but distinct components of cognitive control [14,15]. Therefore, it remains to be examined whether the effects of positive affect on the maintenance-flexibility balance in working memory tasks are modulated by approach motivational intensity in a similar way as has been demonstrated in the cognitive set-switching paradigm.

To this end, the present study used the AX-continuous performance task (AX-CPT) [16,17], which is sensitive to detect the costs and benefits of the active maintenance of task-relevant information under different cue-probe-conditions. In this task, participants are presented with a sequence of letters and instructed to respond to the probe "X" when it is preceded by a specific cue "A" (AX trial) by pressing a pre-specified key (target response). However, participants have to press a different key (non-target response) when the probe "X" follows a "non-A" cue (BX trial), a "non-X" probe follows the "A" cue (AY trial), or a "non-X" probe follows a "non A" cue (BY trial). There are 70% target trials (AX trial) and 30% non-target trials (AY, BX, BY trial, each 10%). In the AX-CPT, the high frequency occurrence of AX trials produces a strong bias to issue a target response, even on AY and BX trials. Improved performance on AY trials (in terms of decreased RTs and/or error rates) can be interpreted as reflecting the increased flexibility and/or reduced cue maintenance (due to rapidly switching the cognitive set when the "non-X" probe follows the "A" cue and/or weaker preparation of the incorrect target response), and improved performance on BX trials (in terms of decreased RTs and/or error rates) can be interpreted as reflecting the enhanced cue maintenance (due to a stronger bias to execute non-target response after the "non-A" cue). Conversely, impaired performance on AY trials (in terms of increased RTs and/or error rates) can be interpreted as reflecting the decreased flexibility and/or enhanced cue maintenance, and impaired performance on BX trials (in terms of increased RTs and/or error rates) can be interpreted as reflecting reduced maintenance. Thus, if low approach-motivated positive affect increases flexibility and weakens maintenance, it should confer improved performance on AY trials and impaired performance on BX trials, compared with neutral affect. In contrast, if high approach-motivated positive affect decreases flexibility and strengthens maintenance, it should confer the opposite pattern: impaired performance on AY trials and improved performance on BX trials.

Intriguingly, mixed evidence has been observed with regard to the effects of low approach- motivated positive affect on the maintenance-flexibility balance in studies using the AX-CPT. Dreisbach [2] found that low approach-motivated positive affect decreased error rates on AY trials and increased RTs and error rates (in Experiment 2) on BX trials, as compared with negative and neutral affect. In contrast, some studies obtained evidence for decreased error rates on AY trials without significant changes on BX trials under low approach-motivated positive affect [18,19]. Recently, Chiew and Braver [20] found increased error rates on AY trials and decreased error rates on other trials.

In sum, the effects of positive affect on the maintenance-flexibility balance in the AX-CPT remain an open question. Further research is required to clarify how low approach-motivated positive affect influences the maintenance-flexibility balance in the AX-CPT, and whether high approach-motivated positive affect has a similar effect as the findings in the cognitive set-switching paradigm.

To address questions from the previous literature, the present study was designed to investigate the effect of low versus high approach-motivated positive affect on the maintenance-flexibility balance in the AX-CPT. In the present study, neutral affect, and high and low approach-motivated positive affect were induced using affective pictures. Based on previous experimental findings and the motivational dimensional model of affect [4,5,9], we tested the following hypotheses: (1) High approach-motivated positive affect would be associated with decreased flexibility and enhanced maintenance, as reflected in impaired performance on AY trials and improved performance on BX trials. (2) Low approach-motivated positive affect would be associated with enhanced flexibility and reduced maintenance, as reflected in better performance on AY trials and poorer performance on BX trials.

2. Methods

2.1. Participants

Sixty undergraduate students (37 females, mean age = 21.52 years, SD = 1.49) participated in the experiment for ¥20. Twenty participants were assigned to the neutral, low approach-motivated positive, high approach-motivated positive affect group, respectively. All participants had normal or corrected-to-normal vision, were right-handed, and were not red-green color-blind. To control the effect of hunger on the effectiveness of dessert pictures to evoke high approach-motivated positive affect, only participants who had eaten 2–4 h before the experiment were allowed to take part. All procedures were approved by the Research Ethics Board of Zhejiang University and all participants provided written informed consent before taking part in the experiment.

2.2. Apparatus

The experiment was run on a computer with a 17-in. monitor (1024 × 768 pixels) at a viewing distance of approximately 57 cm. The viewing distance was kept the same in the experi-