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Conflict adaptation in positive and negative mood: Applying a success-failure manipulation

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ABSTRACT

Conflict adaptation is a cognitive mechanism denoting increased cognitive control upon detection of conflict. This mechanism can be measured by the congruency sequence effect, indicating the reduction of congruency effects after incongruent trials (where response conflict occurs) relative to congruent trials (without response conflict). Several studies have reported increased conflict adaptation under negative, as compared to positive, mood. In these studies, sustained mood states were induced by film clips or music combined with imagination techniques; these kinds of mood manipulations are highly obvious, possibly distorting the actual mood states experienced by the participants. Here, we report two experiments where mood states were induced in a less obvious way, and with higher ecological validity. Participants received success or failure feedback on their performance in a bogus intelligence test, and this mood manipulation proved highly effective. We largely replicated previous findings of larger conflict adaptation under negative mood than under positive mood, both with a Flanker interference paradigm (Experiment 1) and a Stroop-like interference paradigm (Experiment 2). Results are discussed with respect to current theories on affective influences on cognitive control.

1. Introduction

The interface of cognition and emotion has long been a focus of research in cognitive psychology. A particularly intriguing question is how cognitive control processes interact with emotional states (e.g., Davidson, Jackson, & Kalin, 2000; Gray, 2004; Inzlicht, Bartholow, & Hirsh, 2015; Reis & Gray, 2009; Shackman et al., 2011). Considerable research has been carried out to investigate how people control their emotions (see, e.g., Gross, 1999; Ochsner & Gross, 2005; Wells & Matthews, 1994). Recently, a growing body of research has been conducted to investigate the interaction in the other direction, that is, how emotional states modulate cognitive control processes (e.g., Banich et al., 2009; Martin & Kerns, 2011; Mitchell & Phillips, 2007; van Steenbergen, 2015).

One cognitive control process that has been in the focus of interest is conflict adaptation: When the cognitive system detects response conflict in one trial, this leads to an increase in cognitive control in the following trial (Botvinick, Braver, Barch, Carter, & Cohen, 2001; Botvinick, Cohen, & Carter, 2004). Conflict adaptation has been found to be modulated by emotional state, but the exact nature of this modulation is not yet fully understood, as divergent results have been reported in the literature (see, e.g., Dreisbach & Fischer, 2012a, for review). This divergence might be due to conceptual and methodological issues in a) manipulating emotional state and b) measuring conflict adaptation.

1.1. Manipulation of emotional state

Emotional modulations of conflict adaptation have been investigated with different kinds of paradigms. One common method is to insert affective stimuli in between trials (e.g., Braem, Verguts, Roggeman, & Notebaert, 2012; Padmala, Bauer, & Pessoa, 2011; Stürmer, Nigbur, Schacht, & Sommer, 2011; van Steenbergen, Band, & Hommel, 2009; Zeng et al., 2016). However, emotional modulations assessed with this kind of paradigm leave room for at least two kinds of interpretation: First, the affective stimulus might modulate conflict adaptation on the *subsequent* trial (e.g., Padmala et al., 2011). Second, the affective stimulus could be processed as a reward or punishment signal for performance on the *previous* trial (e.g., Braem et al., 2012; Stürmer et al., 2011; van Steenbergen et al., 2009; see also Dreisbach & Fischer, 2012a, for a further distinction between performance-contingent and non-contingent reward). While this method of inserting affective stimuli in between trials is indispensable when investigating *reward-based* modulation, it is not essential for investigating *emotional* modulation of conflict adaptation.

To assess emotional modulations of conflict adaptation, some

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studies have applied sustained mood inductions, where a mood state is induced prior to the assessment of conflict adaptation. This way, modulations of conflict adaptation can be unambiguously attributed to the affective context, and trial-by-trial influences of reward and punishment can be excluded. Studies applying sustained mood inductions have found conflict adaptation to be increased in negative mood relative to positive mood (Kuhbandner & Zehetleitner, 2011; Schuch & Koch, 2015; van Steenbergen, Band, & Hommel, 2010; Van Steenbergen, Band, Hommel, Rombouts, & Nieuwenhuis, 2015). In these studies, mood states were induced prior to assessment of conflict adaptation by presenting emotional music pieces in combination with imagination techniques (Kuhbandner & Zehetleitner, 2011; van Steenbergen et al., 2010), by presenting funny versus neutral cartoons before every run of five trials (van Steenbergen et al., 2015), or by presenting emotional film clips (Schuch & Koch, 2015; see Coan & Allen, 2007; Westermann, Spies, Stahl, & Hesse, 1996, for overviews of mood induction procedures). A potential problem with these kinds of mood inductions is that demand characteristics are rather high. That is, the emotional content of the music or films is rather obvious, rendering it likely that participants will infer the purpose of the mood manipulation; in order to comply with the experimental demands and/or the experimenter's expectations, they might hence report the target emotion even if they do not actually experience that emotional state (e.g., Gilet, 2008; Martin, 1990; Parrott & Hertel, 1999; Westermann et al., 1996). With imagination techniques, participants are directly instructed to try and establish a certain mood state, either by recalling an autobiographic memory or by reading emotional sentences (Velten mood induction procedure); hence, the danger of demand effects is even higher (Berkowitz & Troccoli, 1986; Gilet, 2008; Kenealy, 1986; Larsen & Sinnett, 1991). Alternatively, if participants are aware of the intended mood manipulation, they might engage in emotion regulation strategies in order to counteract the induced mood (Parrott, 1993; Parrott & Hertel, 1999), again leading to distorted measurements of true mood effects.

In order to reduce demand characteristics of the mood induction procedure, in the present study, we applied a success-failure manipulation for mood induction. A meta-analysis showed that this method can reliably induce positive and negative mood states (Nummenmaa & Niemi, 2004; see also Gerrards-Hesse, Spies, & Hesse, 1994; Westermann et al., 1996). Participants receive manipulated success or failure feedback on a task that is relevant to them (e.g., IQ test, or tests measuring social perception skills). The success feedback induces positive mood, whereas the failure feedback induces negative mood, both of which remain for some time such as to influence performance on a subsequent task. Because participants only learn about the manipulation after the end of the experiment, success-failure mood inductions have low demand characteristics. Moreover, ecological validity is high, with participants being actively involved in the emotion-eliciting situation, rather than passively viewing film clips or listening to music (cf. Nummenmaa & Niemi, 2004; see Kofman, Meiran, Greenberg, Balas, & Cohen, 2006, for a quasi-experimental manipulation with high ecological validity).

In the present experiments, we manipulated success versus failure on a bogus intelligence test, considering that feedback on IQ is very likely to be relevant to the self-concept in student participant samples. Adapting the procedure from a previous study (Krohne, Pieper, Knoll, & Breimer, 2002), we used items from a standard IQ test (the progressive matrices test; Raven, 1965). Participants were told that an average person was able to solve 50% of the items. In fact, the Success Group was presented with mainly easy items (such that they would probably solve > 50%), whereas the Failure Group was presented with mainly difficult items (probably solving < 50%). Both groups subsequently performed a speeded choice reaction-time (RT) task where conflict adaptation was measured. With this improved mood-manipulation technique, we expected to find further evidence for increased conflict adaptation in negative relative to positive mood.

To check for the effectiveness of the mood manipulation, a standardized questionnaire (Positive And Negative Affect Scales, PANAS; Krohne, Egloff, Kohlmann, & Tausch, 1996; Watson, Clark, & Tellegen, 1988) was applied at three time points: 1) Before mood induction, 2) immediately after mood induction and just before starting the RT experiment, 3) after the end of the RT experiment. Note that a potential drawback of this manipulation check is that it might increase demand characteristics by drawing participant's attention to their current affective state. However, because we considered it essential to measure the effectiveness of the mood manipulation, and to allow for comparison with our previous study (Schuch & Koch, 2015), we decided to stick with this method of manipulation check.

Moreover, because previous research has shown that it is important to distinguish between affective and motivational influences on cognitive control (Chiew & Braver, 2011, 2014; Dreisbach & Fischer, 2012a; Goschke & Bolte, 2014), we assessed motivational state as well. However, other than affective state, motivational state was only assessed at the end of the RT experiment; this was done to avoid further drawing participants' attention to their current state of feeling and motivation. Hence, our additional assessment of motivational state would only allow us to detect potential differences in motivational states between the groups after the experiment, but would not allow us to assess any short-term effects of the success-failure manipulation on motivational state. Furthermore, because failure manipulations have previously been shown to be particularly effective in participants with low self-esteem scores (Baumeister & Tice, 1985; Brown & Dutton, 1995), we also administered a self-esteem questionnaire prior to the mood induction, in order to check for potential individual differences in responsiveness to the present mood induction.

1.2. Measurement of conflict adaptation

Conflict adaptation can be assessed behaviourally by measuring congruency sequence effects in speeded choice reaction-time tasks; specifically, the reduction of congruency effects after incongruent relative to congruent trials is measured (see, e.g., Duthoo, Abrahamse, Braem, Boehler, & Notebaert, 2014; Egner, 2007, for reviews). When implementing this kind of measure, it is important to control for episodic retrieval effects, which occur when stimulus features repeat from one trial to the next, and which might produce the same pattern of congruency sequence effects (cf. Hommel, Proctor, & Vu, 2004; Mayr & Awh, 2009; Mayr, Awh, & Laurey, 2003). In order to get a measure of conflict adaptation not confounded with feature repetition effects, it is important to use a large stimulus set, and to exclude stimulus repetitions from design and/or analysis (Duthoo et al., 2014; Egner, 2007). Moreover, it is important to control for effects of contingency learning, as these, too, might produce a pattern of congruency sequence effects (Schmidt & De Houwer, 2011; Schmidt & Weissman, 2014). Potential confounds with contingency learning can be avoided by presenting all pairs of relevant and irrelevant stimulus features equally often during the experiment (e.g., Blais, Stefanidi, & Brewer, 2014; Schmidt & Weissman, 2014).

In the present study, we used two different paradigms to measure conflict adaptation, in order to test the reliability of mood-based influences on conflict adaptation across paradigms (cf. Schuch & Koch, 2015; Weissman, Jiang, & Egner, 2014). In Experiment 1, a Flanker interference paradigm was applied (Eriksen & Eriksen, 1974); in Experiment 2, a Stroop-like interference paradigm (cf. Egner & Hirsch, 2005; Notebaert, Gevers, Verbruggen, & Liefooghe, 2006; Stroop, 1935). In both paradigms, the impact of immediate stimulus repetitions was eliminated by using relatively large numbers of stimuli and excluding all trial-to-trial stimulus repetitions from data analysis. This way, the effects of episodic retrieval of previous trial episodes were minimized, which is crucial for an unbiased measurement of conflict adaptation effects (see Duthoo et al., 2014; Egner, 2007, for reviews). Moreover, we controlled for potential effects of contingency learning