Journal of Experimental Social Psychology 45 (2009) 655–666

Contents lists available at ScienceDirect

Journal of Experimental Social Psychology

journal homepage: www.elsevier.com/locate/jesp

Psychophysiological evidence of response conflict and strategic control of responses in affective priming

Bruce D. Bartholow[a,*], Monica A. Riordan[b], J. Scott Saults[a], Sarah A. Lust[a]

[a] Department of Psychological Sciences, 210 McAlester Hall, University of Missouri, Columbia, MO 65211, United States
[b] Department of Psychology, 202 Psychology Building, University of Memphis, Memphis, TN 38152, United States

ARTICLE INFO

Article history:
Received 10 April 2008
Revised 24 February 2009
Available online 5 March 2009

Keywords:
Affective priming
Affective congruency
Response conflict
Categorization
Event-related potentials
ERPs
Lateralized readiness potential

ABSTRACT

This experiment investigated the role of conflict in the response and evaluative categorization systems in the affective congruency effect using event-related brain potentials (ERPs). Participants completed a primed evaluative decision task in which the proportion of congruent to incongruent trials was manipulated. The size of the affective congruency effect increased along with the proportion of congruent trials. ERP data identified the locus of this effect in the response system: the lateralized readiness potential (LRP) showed that preferential response activation occurred in motor cortex following prime onset, and the fronto-central N2 (conflict monitoring) component indicated that conflict occurred when the response activated by the prime differed from the target response, irrespective of the affective congruency of the prime and target. The extent of this conflict covaried with strategic processing of primes, as participants directed less attention to primes that were likely to elicit conflict. These data support a response conflict account of affective congruency effects in the evaluative decision task and indicate that strategic control of attention is important in determining the extent to which conflict occurs.

Introduction

When attitudes or their associated evaluations are activated they have a pervasive effect on decisions and social judgments (see Fazio, 2001). Experimentally, this phenomenon has been demonstrated with various affective priming tasks, in which a valenced prime stimulus precedes a target stimulus that must be classified as either positive or negative (i.e., evaluative decision tasks). As first demonstrated by Fazio, Sanbonmatsu, Powell, and Kardes (1986), targets are categorized more quickly when the prime and target are affectively congruent than when they are affectively incongruent (for a review see Klauer & Musch, 2003). Moreover, at least under some conditions, affective congruency effects occur in ostensibly nonevaluative tasks, such as lexical decision tasks (e.g., Hermans, Smeesters, De Houwer, & Eelen, 2002; Wentura, 1998) and word pronunciation tasks (Bargh, Chaiken, Raymond, & Hymes, 1996; Hermans, De Houwer, & Eelen, 1994).

Early explanations of the affective congruency effect (e.g., Fazio et al., 1986; see also De Houwer & Hermans, 1994; Hermans et al., 1994) focused on spreading activation processes similar to those occurring in semantic priming (e.g., Neely, 1977). Recently, many researchers have instead conceptualized the effect in terms of conflict, although the potential source(s) of this conflict are debated. Klauer and Musch (2003) argued that conflict-like effects in affective priming can stem from synergy and conflict in both response tendencies and in the evaluative categorization process (see also Klauer, Musch, & Eder, 2005). Both are plausible mechanisms, given theory and research indicating that cues that provide information relevant to an upcoming stimulus can act on both stimulus evaluation and response activation (e.g., Gehring, Gratton, Coles, & Donchin, 1992; Meyer, Yantis, Osman, & Smith, 1985; Requin, 1985).

In general, the response conflict model proposes that both primes and targets activate response tendencies (see Wentura & Rothermund, 2003). On congruent trials primes and targets activate the same response tendency, whereas on incongruent trials primes and targets activate opposing response tendencies. Thus, target responses on congruent trials are facilitated, relative to incongruent trials, because the correct target response is partially pre-activated by the prime. In contrast, on incongruent trials the response activated by the prime conflicts with the correct target response, thus slowing its execution. Evidence from several studies supports this model (e.g., De Houwer, Hermans, Rothermund, & Wentura, 2002; Gawronski, Deutsch, & Seidel, 2005; Klauer & Musch, 2002; Klinger, Burton, & Pitts, 2000; Wentura, 1999).

However, other work suggests that the evaluative categorization process might be responsible for the effect. For example, Abrams, Klinger, and Greenwald (2002) found that the affective congruency effect occurred in a subliminal priming paradigm regardless of whether target words were assigned to the same or to the opposite response key during the testing and practice

* Corresponding author. Fax: +1 573 882 7710.
E-mail address: BartholowB@missouri.edu (B.D. Bartholow).

0022-1031/$ - see front matter © 2009 Elsevier Inc. All rights reserved.
doi:10.1016/j.jesp.2009.02.015

Table 1
ERP components of interest in this research and the information-processing operations they represent.

Components	Information-processing operations	Hypothesized neural sources	Relevant citations	Predictions
P3 (or P300)	Evaluative categorization Novelty detection Context updating Subjective probability Decision-making	Widely distributed	Ito et al. (1998) Friedman et al. (2001) Donchin and Coles (1988) Squires et al. (1976) Nieuwenhuis, Aston-Jones, and Cohen (2005)	Slower latency and larger amplitude when evaluative category of the target differs from that of the prime[a]; larger amplitude for low-probability targets/categories
N2 (or N200)	Conflict detection Stimulus infrequency	Medial frontal cortex (anterior cingulate)	van Veen and Carter (2002a and 2002b) Nieuwenhuis et al. (2003)	Larger amplitude when the response activated by the prime differs from the target response, regardless of affective matching
LRP	Preparation for a given overt response	Pre-motor area; motor cortex	Coles (1989) and Coles et al. (1995)	Responses activated by primes depend on probability of given targets, regardless of affective matching with primes

Note. The particular information-processing operation represented by a given component depends upon several factors, including the task or paradigm in which it is elicited. LRP = lateralized readiness potential.
[a] The first prediction listed for the P3 applies to the hypothesis that conflict and facilitation occur during evaluative categorization; other predictions apply to the response conflict hypothesis.

phases. More recently, Klauer et al. (2005) attempted to separate so-called "central" priming (i.e., facilitation and inhibition of target responses during categorization) from response-related priming using a double-dissociation task. Their data revealed priming in both central and response-related processes, though response-related priming effects were much larger than central priming effects.

On the whole, then, the extant literature provides mixed support for a locus of conflict-related affective priming effects in evaluative categorization (e.g., Abrams et al., 2002; Klauer et al., 2005) and response-related processes (e.g., De Houwer et al., 2002; Wentura, 1999; see also Spruyt, Hermans, De Houwer, Vandromme, & Eelen, 2007). Given that both hypothesized mechanisms ultimately have neural sources, augmenting traditional behavioral measures with a brain-based measure could help to disentangle their relative contributions to affective congruency effects. Neural measures have been incorporated in two recent studies of affective priming (Li, Zinbarg, Boehm, & Paller, 2008; Zhang, Lawson, Guo, & Jiang, 2006), but these studies were not focused on investigating the influence of the categorization or response systems. Separating categorization and response processes with behavioral data alone is difficult because behavioral responses represent the cumulative output of both of these systems (and others). This issue can be problematic even in tasks designed to separate responses emanating from different stages of processing, as such tasks tend to assume a serial, discrete-stage model of the information-processing system that often is not supported (see Coles, Smid, Scheffers, & Otten, 1995).

Neural measures of the categorization and response systems

Fortunately, relative involvement of the categorization and response systems can be distinguished by measuring specific components of the event-related brain potential (ERP). The ERP represents a direct and temporally precise measure of the electrical activity of the brain associated with information-processing (see Fabiani, Gratton, & Federmeier, 2007). A number of ERP components (positive and negative deflections in the ERP waveform) have been associated with particular information-processing operations. In general, variation in the amplitude of a given component reflects variation in the level of engagement of the information-processing operation(s) it is thought to represent, while variation in component latency reflects the timing with which those operations are carried out (see Rugg & Coles, 1995).

Three ERP components are of primary interest in this research (see Table 1). First, the latency of the P3 (or P300) component is thought to reflect the speed or ease with which evaluative categorization occurs. Considerable research shows that the latency at which the P3 peaks increases as stimulus evaluation becomes more difficult (e.g., Kutas, McCarthy, & Donchin, 1977; McCarthy & Donchin, 1981; see also Coles et al., 1995). Thus, on the basis of the central priming view (see Klauer et al., 2005), if the evaluative category of the target differs from that of the prime, categorization of the target would be expected to be more difficult, thus leading to slower P3 latency than if the target and prime share an evaluative category.[1]

Two ERP components are useful for determining the extent to which conflict in response processes occurs in affective priming. First, the lateralized readiness potential (LRP) indexes neural activity in pre-motor and motor areas of cortex (see Brunia, 1988; Requin, 1985) associated with preparing and generating behavioral responses (see Coles, 1989; Coles et al., 1995). Specifically, as a participant prepares to make a particular behavioral response, a negativity develops in the ERP that is maximal at central scalp locations contralateral to the responding hand (reflecting the contralateral organization of motor cortex). For example, as a participant prepares to make a left-hand response, the "readiness potential" (see Kornhuber & Deecke, 1965) will be largest over the right side of the scalp, its amplitude directly reflecting how strongly the response is activated (see Coles, 1989). (Additional details about calculation of the LRP are given in the "Method" section and in footnote 5.) Unlike behavioral measures that provide a discreet index of response output, the LRP provides a dynamic measure of response activation over time. Thus, in tasks in which a target stimulus is preceded by a warning cue or prime, the LRP can be used to determine whether and to what extent a response is activated by the prime prior to the onset of the target (see Gratton et al., 1990). Moreover, in tasks involving two response options mapped to opposite hands, the polarity of the LRP reveals which

[1] It is important to note that the concept of "evaluative categorization" in the P3 literature does not necessarily carry an affective connotation, but simply refers to the process of extracting information from a stimulus in order to categorize it in some manner. Moreover, as indicated in Table 1 the P3 is not uniquely associated with evaluative categorization, in that this component is sensitive to a number of other, related processes such as context updating (i.e., updating the contents of working memory; Donchin & Coles, 1988), novelty detection (see Friedman et al., 2001), and subjective probability of the occurrence of task-relevant stimuli (Johnson & Donchin, 1978; Squires et al., 1976). Still, studies in which stimuli are equally novel, familiar, relevant and subjectively likely but differ in their evaluative connotations have shown that the amplitude and latency of the P3 differ as a function of evaluative categories (e.g., Ito, Larsen, Smith, & Cacioppo, 1998; Schupp et al., 2000). Thus, the P3 remains a useful on-line index of the extent to which evaluative categorization processes differ on congruent versus incongruent trials in this research.