Acta Psychologica 159 (2015) 108–115

Contents lists available at ScienceDirect

Acta Psychologica

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

Emotional Stroop Dilution: The boundary conditions of attentional capture by threat words

Michael G. Reynolds [a,*], Robin M. Langerak [b]

[a] Trent University, Canada
[b] Carleton University, Canada

ARTICLE INFO

Article history:
Received 14 October 2014
Received in revised form 7 May 2015
Accepted 11 May 2015
Available online 18 June 2015

Keywords:
Emotional Stroop
Attention
Threat
Cognitive slowing
Automaticity
Visual word recognition

ABSTRACT

It is widely believed that threatening stimuli in our environment capture attention. Much of the core evidence for attentional capture by threatening stimuli comes from the Emotional Stroop task. Yet recent evidence suggests that the Emotional Stroop task does not measure attentional capture (e.g., Algom et al., 2004). The present paper assesses whether threat words can capture attention using a modified Stroop Dilution procedure (e.g., Kahneman & Chajczyk, 1983), where attentional capture by a threat word is inferred from a reduction in color-word interference for threat words compared to non-threat words (emotional Stroop Dilution). The outcome of the present experiments indicates that threat words can capture attention, but only when task demands do not require that a word be attended. It is suggested that threat words produce (1) cognitive slowing, and influence two processes of selective attention (2) attentional capture and (3) the ability to filter irrelevant dimensions of an attended stimulus.

1. Introduction

In order to function adaptively, people need to selectively attend to information that is relevant to their ongoing activities and goals (James, 1890). Given the survival value of evaluating affectively laden stimuli, it is not surprising that there is a large body of work consistent with the claim that negatively valenced information captures our attention (e.g., Reynolds, Eastwood, Partanen, Frischen, & Smilek, 2009). One task that has been used to assess whether negatively valenced stimuli capture attention is the Emotional Stroop task (e.g., McKenna & Sharma, 1995, 2004; Williams, Watts, MacLeod, & Mathews, 1997). In the Emotional Stroop task, participants are asked to identify the ink-color of threat words like "die" and non-threat words like "pie" (see Yiend, 2010; Williams, Mathews, & MacLeod, 1996 for a review). Usually, the different types of words are presented in separate blocks (see Algom, Chajut, & Lev, 2004; McKenna & Sharma, 2004). Under such circumstances, participants are slower to name the ink-color of threat compared to non-threat words (the Emotional Stroop effect). The received view is that the Emotional Stroop effect arises because threat words automatically capture attention away from the ink-color, thereby increasing the time required to respond on these trials (e.g., Williams et al., 1996).

Research with the Emotional Stroop task has long demonstrated that the magnitude of the Emotional Stroop effect is affected by depression and anxiety, and has played a formative role in the development of cognitive models of the corresponding psychopathologies (Williams et al., 1997). The Emotional Stroop task continues to be widely used to study attentional biases for threat as a function of early childhood trauma (Wingenfeld et al., 2009), attachment (Atkinson et al., 2009), borderline personality disorder and posttraumatic stress disorder (Cisler et al., 2011), among others. It has also been used to identify the neural sources associated with emotion (Mitterschiffthaler et al., 2008).

1.1. Problems with the Emotional Stroop task

Recently, a number of researchers have expressed concern that the Emotional Stroop task does not measure attentional biases for threatening information (Algom et al., 2004; Frings & Wühr, 2012; Larsen, Mercer, & Balota, 2006; McKenna & Sharma, 2004). In a seminal paper, Algom et al. (2004) assessed whether the Emotional Stroop effect demonstrates five diagnostic tests of attention, namely whether the effect was (1) sensitive to irrelevant variation, (2) asymmetric for words and colors, (3) dependent upon the salience of the relevant and irrelevant dimensions, (4) observed when neutral and threat words were presented in a mixed list context, and (5) whether the emotion words affected color naming, but not word reading. Given that the Emotional Stroop effect did not pass any of these diagnostic tests, Algom et al. concluded that it does not arise from an attentional bias for threatening information. Instead, they proposed that the Emotional Stroop task

* Corresponding author at: Department of Psychology, Trent University, 1600 West Bank Drive, Peterborough, Ontario K7P 1G8, Canada.
E-mail address: michaelchanreynolds@trentu.ca (M.G. Reynolds).

http://dx.doi.org/10.1016/j.actpsy.2015.05.008
0001-6918/

measures generic cognitive slowing (see also Öhman et al., 2001; McKenna & Sharma, 2004; Chajut, Mama, Levy, & Algom, 2010; and Frings & Wühr, 2012 for additional non attentional capture based accounts). According to the cognitive slowing account, the threat word is processed by a special threat detection system that interrupts all ongoing cognitive processes when a threat is detected. This interruption slows performance in the presence of a threatening stimulus. Unlike the standard interpretation of the Emotional Stroop effect, the cognitive slowing account has nothing to do with the relationship between the ink-color and the word. Therefore, performance decrements do not arise because of a failure to selectively attend to the ink-color.

The conclusion that performance decrements in the Emotional Stroop task do not arise from an automatic attentional bias for threat has important implications for widely held cognitive models of psychopathologies, as well as their diagnostic counterparts, where attentional biases are attributed to individual difference factors such as anxiety and depression (e.g., Derryberry & Reed, 2002; MacLeod, Andrew, & Tata, 1986). This is particularly problematic for models where converging evidence from other methods has not been demonstrated.

1.2. An "Emotional" Stroop task

Although several studies have provided evidence that threat words elicit cognitive slowing (Algom et al., 2004; Frings et al., 2010; McKenna & Sharma, 2004), whether threat words also capture selective attention is still an open question (e.g., Frings & Wühr, 2012; Mama, Behn-Haim, & Algom, 2012). One way to assess whether threat words capture attention would be to modify the Emotional Stroop task so that it passes the five diagnostic tests proposed by Algom et al. (2004). Here, we take this approach by modifying the traditional Emotional Stroop task so that it will be more like the original Stroop task. In the original Stroop task, participants were asked to name an ink-color while ignoring a concurrently presented color word. The stimuli in the Stroop task have a congruency relationship such that the color word and ink-color can be congruent ("blue" in blue ink), incongruent ("blue" in red ink) or neutral ("car" in blue ink). The Stroop effect (slower responses when naming the ink-color on incongruent trials compared to congruent trials) is a hallmark failure of selective attention (Algom et al., 2004; MacLeod, 1991) and is sensitive to the five diagnostics of attention used by Algom et al. (2004) to examine the Emotional Stroop effect. Therefore, adding a congruency component to the Emotional Stroop task makes it possible to assess whether threat words can automatically capture attention.

Recently, Chajut, Schupak and Algom (2010) added a congruency component to the Emotional Stroop task to assess whether there is an attentional bias for threat words. In Chajut et al.'s experiments, two stimuli were presented on each trial: a color word and a distractor word (threat vs. non-threat; see Cho, Lien, & Proctor, 2006; Kahneman & Henik, 1981; Roberts & Besner, 2005 for the use of this procedure without threat words). The distractor word was always the colored item and the color word could either be congruent or incongruent with the target color (see Fig. 1, panel A). Participants were instructed ignore the meaning of the words while naming the ink-color of the distractor word. Previous research using this procedure (without emotional words) has indicated that when the color carrying stimulus is a word-like stimulus, the impact of the color word is reduced (Roberts & Besner, 2005). This effect is often called Stroop Dilution (Kahneman & Chajczyk, 1983) and is argued to arise because the word-like stimuli at fixation utilize attention. Consistent with automatic attentional capture by the threat words, the Stroop effect in Chajut, Schupak et al.'s (2010) study was smaller in the presence of a threat word than in the presence of a non-threat word (emotional Stroop Dilution).

2. Experiment 1

Although Chajut, Schupak et al.'s (2010) experiments are consistent with automatic attentional capture by threat words, the type of distractor was blocked such that in one block the distractor was always a threat word and in another block the distractor was always a non-threat word. Blocking the emotional valence of the distractor word raises the possibility that differences in performance across the threat and non-threat conditions were due to top-down differences in attentional set, rather than differences in attentional capture (Algom et al., 2004; Francolini & Egeth, 1980). In order to assess whether the emotional Stroop Dilution reported by Chajut, Schupak et al. (2010) is due to attentional capture, the first experiment assesses whether emotional Stroop Dilution is still observed when the threat and non-threat distractors are randomly intermixed in a single block of trials. As noted by Algom et al. (2004), one of the hallmarks of automatic attentional capture is that its effects are still observed under mixed list conditions. Indeed, the conclusion that the Emotional Stroop effect does not arise from the capture of selective attention away from the color and towards the word is predicated, in part, on the observation that the Emotional Stroop effect is eliminated in a mixed list context (Algom et al., 2004; Frings et al., 2010; Holle, Neely, & Heimberg, 1998; Richards, French, Johnson, Naparstek, & Williams, 1992; McKenna & Sharma, 2004). Therefore, a failure to observe emotional Stroop Dilution when the stimuli are randomly intermixed would suggest that the emotional Stroop Dilution reported by Chajut, Schupak et al. (2010) is not due to attentional capture by a threat word.

2.1. Method

2.1.1. Participants

Eighteen students from Trent University participated in the present study for credit in an undergraduate psychology course. All students reported normal or corrected to normal vision and normal color perception.

2.1.2. Stimuli

The ink-colors were the standard E-Prime colors for red, yellow blue and green (Schneider, Eschman, & Zuccolotto, 2002). The word stimuli consisted of two sets of character strings, color words and distractor words. The color words consisted of the words RED, YELLOW, BLUE and GREEN and neutral nonwords (e.g., #&@). The nonwords were derived from non-alphanumeric characters from the top of the keyboard and matched to the color-words on length (see Roberts & Besner, 2005). The color words were used in conjunction with the ink-colors

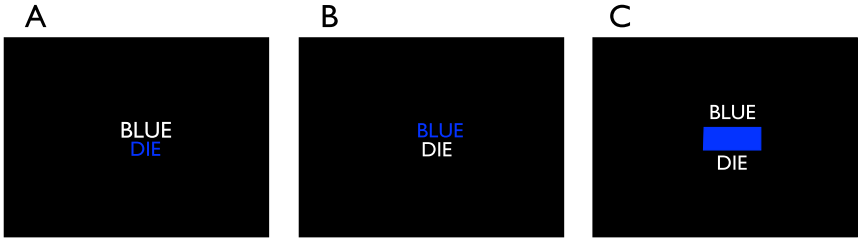

Fig. 1. Examples of the displays used in Experiment 1 (panel A), Experiment 2 (panel B) and Experiment 3 (panel C).