

THE EMOTIONAL STROOP EFFECT IS A GENERIC REACTION TO THREAT, NOT A SELECTIVE REACTION TO SPECIFIC SEMANTIC CATEGORIES

Boaz M. BenDavid¹, Leora Levy², and Daniel Algom¹

¹Department of Psychology, Tel-Aviv University

boazb@post.tau.ac.il

²Department of Communication Disorders, Tel-Aviv University

Abstract

Participants named the print color, read or made lexical decisions of emotional and neutral words presented in separate blocks or mixed in a random fashion. Color naming was slower for emotional than for neutral words in blocked presentations, thereby documenting the typical Emotional Stroop Effect (ESE). The ESE was not found in mixed presentations. Notably, a slowdown for emotional words was also found for reading and lexical decision, thereby challenging the assumption of comparable semantic processing across the two types of words. Collectively, the results are consistent with an interpretation of ESE in terms of a general-purpose defense mechanism that responds to threat by temporarily freezing all ongoing activity.

In the "emotional Stroop paradigm," participants are asked to name the color in which various words are printed. Naming the color of words with emotional connotation is performed slower than that of neutral words. This difference is labeled the "emotional Stroop effect" and is theorized (Williams, Mathews, & MacLeod, 1996) to be the product of subliminal processes of word reading interfering with the color naming response. If the participant focuses exclusively on the print colors and ignores the carrier words, then no difference in color naming between emotional and neutral words is observed. The emotional Stroop effect is therefore an indication of the failure to pay exclusive attention to print color.

The emotional Stroop paradigm is very popular in current clinical psychology (see Williams et al., 1996, for review). The effect has been demonstrated with a variety of psychopathological populations, using emotional words related to the respective clinical conditions. There have been few studies investigating the emotional Stroop effect with non-pathological subjects. In one such study, McKenna and Sharma (1995) presented participants with emotional words with threatening connotations (e.g., failure, death) and neutral words. The results showed longer reaction times (RTs) for naming the color of threatening words than for naming the color of neutral words.

The widespread belief that the emotional Stroop effect is the product of subliminal semantic processing reflects the implicit assumption that there are no differences in reading across the emotional and neutral words. As a result, in virtually all experiments only color naming but not reading is tested. However, in a recent study (Lev, 2002), participants were asked not only to name the color of the words, but also to read them out loud (in separate tasks). Lev found that the participants read emotional words slower than they read neutral words. Therefore, in Lev's study the emotional words disrupted color naming and reading to the same extent. These results raise the possibility that emotional stimuli interfere with any ongoing activity (color naming as well as reading). If this is indeed the case, then it is possible that the emotional Stroop effect is a general-purpose defense mechanism sensitive to threat, and not a selective attention mechanism.

Nevertheless, it can be argued that reading in Lev's study was disrupted by the reluctance of participants to call aloud threat or taboo words. Therefore, in the present study we introduced the lexical decision task as another tool to measure performance in the context of the emotional Stroop phenomenon. In a typical lexical decision task, a string of letters is presented, and the participant is required to decide, while timed, whether it is a legitimate word. In both the reading and the lexical decision tasks, participants are required to focus their attention on the words. However, in the latter task a verbal response is not required; therefore, slower RTs for lexical decision of emotional words must be interpreted as the response of a defense mechanism rather than a strategic response to avoid spelling out taboo words.

The emotional Stroop effect has been typically tested by presenting words of a given type (neutral or emotional) in separate blocks. Neutral words were presented together in a single experimental block, and the emotional words were similarly presented together in another block. We hypothesized that the interference found in those studies was not due exclusively to the processing of each discrete target word, but rather due to the cumulative effect of all previous emotional words. To examine this hypothesis, in our study we compared two presentation types of the stimuli: (a) separate blocks of neutral and emotional words, and (b) mixed presentation in which emotional and neutral words appear randomly in the same block. If emotional stimuli create a cumulative effect, than a mixed presentation should diminish the emotional slowdown. Therefore, the difference in RT between emotional and neutral words in the mixed presentation will be smaller than in the blocked presentation.

Method

Participants 56 participants, students recruited from the Department of Psychology, Tel Aviv University, volunteered to take part in the experiment.

Stimuli and apparatus 32 words were used. There were 16 names of items of clothing (e.g., hat, shoes) having neutral connotation, and 16 emotionally charged words associated with terrorism (e.g., terrorist, death). Words were balanced in terms of length and frequency of usage within the student population. Another 32 strings of letters that do not form words in the Hebrew language (non-words) were used. Non-words were balanced in terms of word length against the neutral and emotional words, and were rated by participants in a pretest as highly resembling Hebrew words. Stimulus presentation and measurement of RTs were performed by a Macintosh computer with a keyboard and a microphone, using PsyScope (version PPC 1.2.5) software. Words were presented in blue, red, green, and gray on a white background in Arial font (size 48), on a 17" color screen.

Procedure Participants were tested individually, divided randomly into four experimental groups as shown in Table 1. Half the participants preformed a reading task before the color naming task. The other half preformed a lexical decision task, before the color naming task. These two groups were further divided into two subgroups according to different presentation types: blocked and mixed.

Table 1: Four Experimental Groups Defined by the Word Task (Reading, Lexical Decision) and Type of Presentation (Separate Blocks, Mixed). All the Participants also Performed in a Subsequent Color Naming Task.

Type of Presentation	Blocked	Mixed
Task		
Reading	N = 14	N = 14
Lexical Decision	N = 14	N = 14

Task description:

Reading 32 words were presented in 4 different colors. The participant was asked to read aloud into a microphone, as quickly and accurately as possible, the words presented on the screen.

Lexical decision 32 words and 32 sequences non-word strings were presented in 4 different colors. The participant was asked to press, as quickly and accurately as possible, one key ("yes") if the stimulus was a correct lexicon word in the Hebrew language, and another key ("no") if the stimulus was not a proper word.

Color Naming 32 words were presented in 4 different colors. The participant was asked to name, as quickly and accurately as possible, the print color of the word appearing on the screen.

Stimuli were response-terminated with an interval of 1 second between the words. The experimenter recorded the correctness of responses, and errors were excluded from the analysis. Practice trials were presented before each task; these trials were also not included in the analysis.

Results and Discussion

Shown in Table 2 are the mean RTs for the various experimental conditions. For the color naming task presented in the traditional blocked fashion, the RTs for emotional words were significantly longer than RTs for neutral words, showing the typical emotional Stroop effect. For reading performed in blocked presentation, the results replicated Lev's (2002) findings, showing a slowdown for emotional words. For lexical decision, the results showed an emotional slowdown effect regardless of type of presentation. Therefore, in all three tasks (color naming, reading, and lexical decision) the results showed a substantial disruption of ongoing activity with emotional word stimuli in blocked presentation. This non-specific emotional slowdown is a signature of the present findings with non-pathological participants. The symmetry in interference in all three tasks undermines the traditional theoretical rationale for the emotional Stroop task, namely that it is a phenomenon of attention. The results implicate a generic inhibitory defense mechanism whereby threatening stimuli disrupt all ongoing activity.

The accepted justification for the traditional methodology used to measure the emotional Stroop effect (color naming), is that that it provides an indirect evidence of differential semantic processing. However, since a difference in semantic activation is revealed directly through reading or lexical decision, using the indirect measure seems no longer justified.

Table 2: Mean Response Times (in milliseconds) to Neutral and Emotional Words. Emotional Slowdown = RT(emotional) – RT(neutral). Asterisks indicate a statistically significant difference.

Word Type Task	Blocked presentation			Mixed presentation		
	Neutral	Emotional	Emotional Slowdown	Neutral	Emotional	Emotional Slowdown
Color naming	574	594	20* N = 28	627	627	0 N = 28
Reading	505	568	63* N = 14	574	585	11* N = 14
Lexical decision	574	626	52* N = 14	554	580	26* N = 14

Examining the results for color naming in a mixed presentation, one observes further support for the notion of a defense mechanism causing the emotional slowdown. The emotional Stroop effect in color naming was no longer present when stimuli were presented randomly interspersed in a single block. There was no difference between RTs for emotional and neutral words. This indicates that the context of other emotional stimuli interferes with color naming. A similar pattern of results was obtained in the reading and lexical decision tasks. Although the emotional slowdown is still apparent in mixed presentations, it was less appreciable than the emotional slowdown observed in blocked presentations. When words are presented in a blocked presentation, emotional words are always preceded by other emotional words, engendering a cumulative effect of emotional slowdown. Our results show the cumulative effect to be larger than the "freeze" effect caused by the presentation of merely one emotional word.

The emotional Stroop effect has traditionally been considered as an attention phenomenon. Our results indicate that emotional stimuli affect all ongoing activity, and not only activity requiring attention such as color naming. In addition, the effect engendered by the emotional stimuli occurs not only for the word currently presented, but probably more intensely for words presented after the current emotional words. The effect seems to be caused by a defense mechanism that responds to threat by temporarily freezing all ongoing activity, and not by a selective attention mechanism.

References

- Lev, S. (2002). Being Rational About Emotional Stroop. Unpublished doctoral dissertation, Tel Aviv University.
- McKenna, F. P., & Sharma, D. (1995). Intrusive cognitions: An investigation of the emotional Stroop task. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 21 (6), 1595-1607.
- Williams, J. M., Mathews, A., & MacLeod, C. (1996). The Emotional Stroop task and psychopathology. *Psychological Bulletin*, 120, 3-24.