

## Psychological distress and responses to blocked and random presentation of emotional Stroop stimuli; an online experiment.

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### Abstract

There is an extensive amount of literature utilising the emotional Stroop task (EST) to investigate attentional processes underlying a range of psychological conditions. Relatively fewer studies have specifically examined the impact of different Stroop stimuli presentation methods (i.e., blocked or mixed presentation of words). The aim of this study was to directly investigate this issue using an online version of the task. After an initial practice trial, 117 Psychology students (19 Male, 98 Female) were randomly allocated to either a random or counterbalanced blocked condition. Demographic information and level of psychological distress (K10) were also collected. Results indicated that there were no significant differences between blocked and random conditions on attentional interference. Further analysis indicated that random presentation produced significantly higher levels of response latencies to emotional words in participants with high levels of psychological distress. These data add to the methodological debate surrounding the use of blocked vs. random presentation of Stroop stimuli. Implications of these results for assessing control and clinical groups using the EST are discussed.

**Keywords:** *Emotional Stroop; Psychological Distress.*

### Introduction

Numerous studies have utilised the emotional Stroop task to investigate the degree of attentional bias exhibited by individuals toward stimuli associated with a current psychological condition or disorder (see MacLeod, 1991; Williams, Mathews, & MacLeod, 1996 for reviews). Based on the traditional colour-naming Stroop paradigm (Stroop, 1935), the emotional Stroop task provides a measure of attentional bias by assessing colour-naming response times to neutral and emotionally-relevant word stimuli (McKenna, 1986). Differences in response times to emotionally laden

words associated with a current psychological concern (e.g., anxiety) in comparison to neutral stimuli (e.g., chair) represents an index of attentional bias (cognitive interference). Generally, when compared to neutral stimuli, individuals are found to be significantly slower to colour-name emotional words relevant to a current psychological concern (see Williams et al., 1996).

An extensive number of studies have examined this phenomenon. Examples of studies providing evidence of an association between increased response latency and pathology include: increased interference by high-trait anxiety or anxiety disordered individuals in response to anxiety-oriented stimuli (see Becker, Rinck, Margaf, & Roth, 2001; MacLeod & Rutherford, 1992; Macleod & Hagan, 1992; Martin, Williams, & Clark, 1991; Mathews & MacLeod, 1985); maths anxious individuals and math-oriented Stroop stimuli (Hopko, McNeil, Gleason, & Rabalais, 2002); phobic individuals using phobia-oriented Stroop stimuli (Amir, Freashman, & Foa, 2002; Van Den Hout, Tenney, Huygens, & De jong, 1997; Watts, McKenna, Sharrock, & Trezise, 1986); and increased interference by depressed individuals on depressed/negative-oriented stimuli (Dudley, O'Brien, Barnett, McGluckin, & Britton, 2002).

However, within this literature there is considerable variability in the method of Stroop stimuli presentation. Specifically, some studies present the neutral and emotional words in separate "blocks". Others have presented the words randomly in a "mixed" condition. Evidence suggests that these presentation methods may not be psychometrically equivalent (Waters, Sayette, & Wertz, 2003), however there are relatively few studies that have specifically investigated this issue. The available findings indicate that blocked presentation of word stimuli produces stronger effects than those observed when presentation is random (e.g., Holle, Neely, & Heimberg, 1997; Jones-Chesters, Monsell, &

Cooper, 1998; Richards, French, Johnson, Naparstek, & Williams, 1992; Waters et al., 2003).

The superiority of blocked presentation in producing emotional Stroop effects has been reported in studies of high trait anxious individuals (Richards et al., 1992), individuals diagnosed with social phobia (Holle et al., 1997) and individuals diagnosed with bulimia and anorexia nervosa (Jones-Chesters et al., 1998). For example, Richards et al. (1992) reported a significant positive association between levels of trait anxiety and interference values only when emotional words were presented in a blocked format. This correlational finding was supported by a between-groups analysis which indicated that the high trait anxiety group exhibited significantly longer response times to the emotional words in the blocked condition in comparison to random presentation (Richards et al., 1992).

Similar findings were reported in a study of individuals diagnosed with eating disorders (bulimia and anorexia nervosa; Jones-Chesters et al., 1998). Specifically, Jones-Chesters et al. (1998) revealed an overall emotional Stroop effect for both disorder groups in response to food and weight word stimuli, regardless of presentation method (blocked vs. random). Individuals diagnosed with bulimia nervosa also exhibited cognitive interference in response to 'general' emotional words related to depression and anxiety suggesting a higher level of general psychopathology in this group. Of importance to the current study is the finding that these interference effects were exacerbated when words were presented in blocked format.

Holle et al. (1997) reported a similar finding in their study of individuals diagnosed with social phobia. Specifically, as opposed to random presentation, participants in the blocked condition exhibited significantly longer latencies on social threat words in comparison to neutral words. In addition, participants also displayed significantly longer response latencies on the blocked related neutral words in comparison to the blocked unrelated neutral word condition.

Thus, there is a consistent trend in the limited available literature to indicate that interference effects are more pronounced when emotional Stroop stimuli are presented in blocked rather than mixed format. There appear to be two major theoretical explanations for this finding. Firstly, it has been argued that blocked presentation produces a mood 'build up' effect resulting from increased rumination and cumulative reflection on word meaning (Holle et al., 1997; Jones-Chesters et al., 1998; Richards et al., 1992). That is, repeated exposure to emotionally-relevant words leads to increased

response latencies as participants gradually become more preoccupied with the emotional stimuli over the course of the trial.

Secondly, carry-over effects have been identified as a factor in reducing the emotional Stroop effect when mixed presentations are employed (e.g., Waters et al., 2003). Specifically, there is now data to indicate that individuals respond more slowly to words presented directly after exposure to an emotional word (Waters et al., 2003). Thus, the interference produced by the emotional word 'carries over' to the subsequent word which may be a neutral stimulus. Consequently, emotional carry-over effects may produce increased response time to neutral word stimuli thereby reducing the size of the emotional Stroop effect (Waters et al., 2003).

Despite this, it is interesting that some evidence indicates little difference between blocked and random presentation when certain word stimuli are presented (e.g., Cassiday, McNally, & Zeielin, 1992; Kaspi, McNally, & Amir, 1995). For example, Cassiday et al. (1992) reported no differences between blocked and mixed conditions on response latencies to high-threat words in individuals diagnosed with post-traumatic stress disorder. Similarly, Kaspi et al. (1995) in a study of Vietnam veterans, found only non-significant differences between presentation method on levels of interference to combat-related stimuli.

Thus, while the majority of studies to date provide support for blocked presentation in producing increased response times to emotional stimuli, there are some inconsistent findings. It is argued that additional research is warranted, given the relative lack of studies aimed at specifically addressing this issue. The aim of the current study is to directly assess differences in response times to neutral and emotional word using both blocked and random presentation methods. In addition, the current study aimed to investigate the relationship between non-pathology specific emotional word latencies and a general measure of psychological distress. To this end, an online version of the emotional Stroop task (OEST) and the K10 psychological distress questionnaire (Kessler, Andrews, Colpe, Hiripi, Mroczek, Normand, Walters, & Zaslavsky, 2002) was administered to a sample of students as part of a course activity. It was hypothesised that individuals would take significantly longer to colour-name emotional words compared to neutral words; levels of psychological distress would be positively related to interference (emotional response time minus neutral response time) values, and finally, when compared to mixed presentation, individuals would exhibit longer

response latencies to emotional words presented in blocked format.

## Method

### Participants

One hundred and seventeen participants (age,  $M = 24.52$ ,  $SD = 8.22$ ) enrolled in an undergraduate Cognitive Psychology unit completed the OEST and K10 questionnaire. A large proportion of participants were female (83.8%) and the majority of students were studying full time (82.9%).

### Measures

#### Online Emotional Stroop Task (OEST)

The Emotional Stroop Task consisted of one practice trial (24 stimuli) which presented a series of coloured x stimuli (either xxxx or xxxxx). Following the practice trial were 4 experimental trials consisting of 40 stimuli each. Depending on allocation to experimental conditions, participants received either randomised words or blocked words (counterbalanced). Order of word presentation (emotional first vs. neutral first) was also counterbalanced in the blocked condition. Emotional words were fear, death, crash, fail and grief; neutral words were field, thumb, clock, note and gate (McKenna, 1986). Participants were instructed to respond as quickly and as accurately as possible by identifying the colour of the stimulus whilst ignoring its meaning. The task was completed online using a link from the Cognitive Psychology unit website.

#### Psychological Distress: K10 (Kessler et al., 2002)

The K10 is a brief questionnaire measuring general psychological distress. Items assess frequency of depressed mood, fatigue and anxiety “during the last 30 days” (most of the time, some of the time, a little of the time, none of the time). Psychometric data indicate excellent validity as the scores on the scale were found to distinguish between DSM-IV cases from controls (Kessler et al., 2002). In addition, the K10 demonstrates high sensitivity for detecting general psychological distress in a community sample. High levels of internal consistency have also been reported (Cronbach’s alpha = 0.93; Kessler et al., 2002)

### Procedure

Students enrolled in the Cognitive Psychology course were asked to complete the OEST at a convenient time and location. Information was provided during the first lecture of semester and

students who agreed to participate were asked to sign individual consent forms.

The task was accessed via a link from the unit website. After clicking on this link, participants were directed to a brief demographic questionnaire (gender, age, study load). Following this, participants were presented with an instruction screen detailing the OEST. After completing the OEST participants were presented with an online version of the K10.

### Design

A between-groups design was employed examining differences between high and low distress participants and between presentation method (blocked vs. random) on response times to neutral and emotional words. Participants were divided into high/low psychological distress groups using a median split procedure (K10 scores). The primary analysis of this study is focused on mean interference. This variable is computed as emotional response time minus neutral response time (e.g., Richards et al., 1994). Consequently, higher scores indicate increased relative response time to emotional word stimuli compared to neutral words.

## Results

### Error rate analysis

On average, participants committed 6.6 errors ( $SD = 9.03$ ) during the experimental phase. This equates to a mean error rate of 4.13% for each participant. There were no significant differences in error rate between blocked and random presentation  $F(1,113) = 1.46$ ,  $p > .05$ , nor between high and low K10 participants  $F(1,113) = 1.48$ ,  $p > .05$ . Participants who committed errors ( $n = 81$ ) did not significantly differ from those who did not commit any errors ( $n = 36$ ) on mean interference  $t(115) = .25$ ,  $p > .05$ . Given these findings, all subsequent analyses are conducted using the complete data set.

### Descriptive Statistics

Table 1 displays means and standard deviations for response times (RT in milliseconds) during practice and in response to neutral and emotional words as a function of condition (blocked vs. random). A multivariate between-groups analysis of variance revealed no differences between blocked and random presentation on any of these variables (see Table 1).

Table 2 displays means and standard deviations for response times as a function of psychological distress level. Participants were divided into high/low distress

Table 1: Means and standard deviations for practice, neutral and emotional trial response times as a function of condition.

Variable	Blocked ( $n = 53$ )		Random ( $n = 64$ )		$F(1, 115)$
	$M$	$SD$	$M$	$SD$	
Practice RT	978.47	229.48	961.67	297.92	0.11
Neutral RT	893.68	117.77	884.77	167.01	0.10
Emotional RT	886.44	116.57	895.23	178.58	0.09

Note. RT = Response time.

groups on the basis of K10 scores using a median-split procedure (median = 18). This resulted in 55 'high distress' participants ( $M = 25.54$ ,  $SD = 5.97$ ) and 62 'low distress' participants ( $M = 14.85$ ,  $SD = 2.42$ ),  $t(115) = 11.74$ ,  $p < .05$ . A between-groups MANOVA revealed no significant differences between distress groups on response times, although the longer response times to emotional words exhibited by the high distress group approached significance (see Table 2).

random condition when compared to the blocked condition. Simple effects analysis confirmed this revealing a significant difference between blocked and random presentation for the high distress group  $F(1, 53) = 7.37$ ,  $p < .05$ , but no difference for the low distress participants  $F(1, 60) = 0.86$ ,  $p > .05$ .

Table 2: Means and standard deviations for practice, neutral and emotional trial response times as a function of psychological distress level.

Variable	Low Distress ( $n = 62$ )		High Distress ( $n = 55$ )		$F(1, 115)$
	M	SD	M	SD	
Practice RT	946.51	194.66	994.95	332.17	0.95
Neutral RT	870.26	106.34	909.71	179.80	2.14
Emotional RT	865.88	108.98	919.84	187.99	3.70 <sup>a</sup>

Note. RT = Response time, <sup>a</sup>  $p = .057$ .

### Correlational Analysis – Distress and response times

A Pearson correlational analysis was performed on the data to examine linear relationships amongst response times and psychological distress. The analysis revealed a marginally significant correlation between distress and response times to neutral words ( $r = 0.19$ ,  $p < .05$ ) and a stronger association between distress and emotional word response time ( $r = 0.24$ ,  $p < .01$ ). Psychological distress scores were not significantly related to practice RT ( $r = 0.15$ ,  $p > .05$ ). This indicates that levels of psychological distress were associated more strongly with increased response latencies to colour-naming emotional words.

### Cognitive Interference

Mean interference was calculated as emotional RT minus neutral RT. Thus, positive scores on this variable indicate increased colour-naming response time to emotional words relative to neutral words. A 2 (blocked vs. random condition) x 2 (high vs. low distress) between-groups ANOVA was conducted to assess the influence of these two variables on levels of interference. This analysis revealed no main effect of condition  $F(1, 113) = 2.99$ ,  $p > .05$ , or distress  $F(1, 113) = 0.67$ ,  $p > .05$ . However, a significant interaction between condition and distress was observed  $F(1, 113) = 7.92$ ,  $p < .05$ . Figure 1 illustrates the interaction of these variables on mean interference.

From Figure 1, it is evident that the high distress group exhibited greater cognitive interference in the

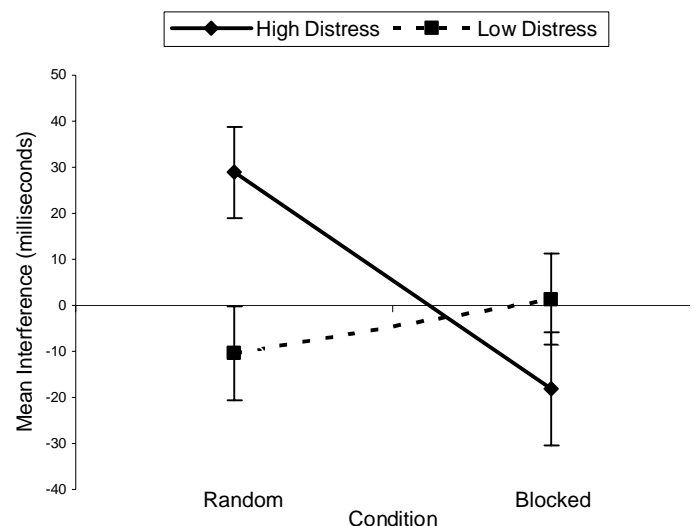


Figure 1: Interaction between condition and distress level on mean interference (error bars display  $\pm$  SEM).

### Discussion

The primary aim of this study was to investigate the differential impact of blocked and random presentation of emotional Stroop stimuli on attentional bias. In addition, the study examined the relationship between general psychological distress and levels of interference in response to both blocked and random presentations.

Contrary to predictions, response times demonstrated considerable stability across blocked and random conditions. Specifically, there were no significant differences between blocked and random presentation on response times to neutral or emotional stimuli. Similarly, levels of interference were the same across conditions. This is in accordance with Cassiday et al. (1992) and Kaspi et al. (1995) who also reported no differences in response times between blocked and random presentation. However, the influence of blocked and random presentation on producing interference was found to be dependent on psychological distress. That is, for individuals with high levels of self-reported distress, random presentation elicited significantly more interference in comparison to blocked presentation.

While these results are not in the hypothesised direction, they do indicate that differing presentation of emotional Stroop stimuli may produce differential effects (e.g., Waters et al., 2003) and that this appears to be influenced by a relevant psychological concern (e.g., Holle et al., 1997; Jones-Chesters et al., 1998; Richards et al., 1992). The finding that random presentation was more effective in producing interference in high distress individuals is inconsistent with prior work which has supported the superiority of blocked presentation (e.g., Richards et al., 1992).

It is evident that in the current study blocked presentation failed to produce the cumulative mood 'build-up effect' required to elicit interference. An explanation for this finding could be that over the course of the trial, participants habituated to the presentation of the emotional words (Cassiday et al., 1992). Habituation would serve to reduce response times to emotional words during blocked presentation as participants become gradually accustomed to the negative emotional words. It is possible that since the current sample was not clinical in nature, participants may have been less affected by blocked presentation of emotional stimuli. That is, given that the emotional stimuli were not directly related to a specific psychological *disorder*, habituation ensues resulting in reduced interference. Interestingly, and consistent with this conceptualization, Cassiday et al. (1992) found reduced interference to neutral and positive words presented in a blocked format. These authors concluded that under such circumstances (i.e., non-threatening words) habituation is likely to occur (see also Richards et al., 1992). Thus, it is possible that the emotional words were not sufficiently negative or directly tied to a specific psychological concern to produce the mood build up effect in the blocked condition as reported by others using clinical samples (e.g., Holle et al., 1997; Jones-Chesters et al., 1998).

Future research examining the issue of habituation to blocked emotional Stroop presentation in non-clinical populations is warranted.

Given the non-clinical sample, the significant association between emotional word response time (overall) and general psychological distress is of some importance. This indicates that even non-clinical levels of psychological distress may result in attentional bias toward stimuli associated with such concerns (e.g., Williams et al., 1996). Thus, the use of an online version of the emotional Stroop task appears to be effective in tapping this attentional bias in individuals with higher levels of general distress. It would be of theoretical and applied interest to investigate whether the current pattern of results is replicated in a clinical population.

Some methodological constraints warrant consideration. Firstly, online administration of the task introduces a number of possible extraneous variables which may have influenced performance. For example, differences between administrations in terms of lighting, noise and other environmental factors cannot be controlled with this method. Additional research aimed at further validating online versions of the emotional Stroop task would allow for some more concrete conclusions to be drawn regarding the impact of these potentially confounding variables. Secondly, the sample, although large, was relatively restricted as all participants were university students.

Overall, this study has provided some additional insight into the influence of differing presentation methods in eliciting differential interference effects. While the data were not consistent with the prediction that blocked presentation would produce the most interference, they nonetheless indicate that presentation method is important in understanding associations between psychological states and attentional bias. It is possible that the emotional words were not sufficiently negative or psychologically specific to produce a cumulative mood build up effect in a non-clinical sample. Future research employing different modes of presentation and a more varied sample may shed some additional light on the processes involved in attentional bias to emotionally relevant stimuli.

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### Research Profile

Dr. Nicolas Kambouropoulos is a lecturer in Psychology, Faculty of Life and Social Sciences, Swinburne University of Technology. His main interest is in studying the cognitive and personality factors involved in addictive behaviours. In particular, Dr. Kambouropoulos is interested in the role of neurologically based behavioural approach and inhibition systems in regulating personality, affect and substance use.

Dr. Simon Knowles is a lecturer in Psychology, Faculty of Life and Social Sciences, Swinburne University of Technology. Research interests include investigating the impact of work lifestyle (specifically shiftwork) and the mediating role of stress and various coping strategies on individual psychological and physiological well-being, Psychoimmunity, and cognitive processes underlying psychopathology. Dr Knowles is also supervising a number of graduate students in a range of clinical and health areas in addition to those mentioned above.