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Generalizability of carry-over effects in the emotional Stroop task

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Abstract

The emotional Stroop task has been the most widely used task to examine attentional bias to emotionally salient stimuli. In one format of this task, words are presented to participants in a mixed randomized or quasi-randomized sequence. Using a mixed smoking Stroop task, we have previously demonstrated that smokers are slower to respond to words which follow smoking-related words than words which follow neutral words. Here we show that this carry-over effect is present in heroin addicts—but not control subjects—in a heroin Stroop task, and in normal subjects in a stress Stroop task. Thus, the effect generalizes to other populations. In addition, an examination of the studies that have collected data from both mixed and blocked formats provides converging evidence for the presence of carry-over effects. We discuss the implications of the carry-over effect for research using the emotional Stroop task.

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The Stroop task has been widely used as a tool for assess the mechanisms of selective attention (Stroop, 1935). Indeed, the Stroop task has been referred to as the “gold standard” of attentional

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measures (MacLeod, 1992). Much recent research has used a modified (or emotional) Stroop task to examine whether individuals exhibit an attentional bias to stimuli related to their current concerns or pathology (Williams, Mathews, & MacLeod, 1996). The modified Stroop task indexes attentional bias by measuring the degree to which individuals are slower to name the color of concern-related words than neutral words. In many studies, the colored words are presented on cards, and the difference in color-naming times for concern-related and neutral cards—the Stroop effect—provides a measure of the attentional bias. Because the card format requires little equipment (card and stopwatch), it has the advantage that it is easy to set up and administer in both clinical and non-clinical settings.

In recent years the majority of studies have used computers to present the words. In computerized versions, stimulus words are presented individually, and so it is possible to derive reaction time data for individual stimulus words. These data can facilitate word selection and psychometric analyses. Two presentation formats have been used. First, the words from each set (e.g., concern and neutral) can be presented in separate “blocks” (a “blocked” procedure). In common with the card format, the order of completion of the neutral and concern-related words is typically counterbalanced. The blocked format seems conceptually similar to the card format, which may facilitate comparisons across studies, and it has the advantage noted above that it can provide data on individual items. In the second format, the words from the concern-related and neutral sets can be presented in a mixed randomized or quasi-randomized sequence (an “unblocked” or “mixed” procedure). An advantage of the mixed format is that it obviates the need for counterbalancing. All these formats (i.e., card, computer-blocked, computer-mixed) are regularly used, and they are tacitly assumed to measure the same underlying construct, attentional bias.

However, different formats of the emotional Stroop task may not be psychometrically equivalent instruments. Kindt, Bierman, and Brosschot (1996) have noted a lack of convergent validity for different Stroop formats (card vs. computer), and a number of studies have documented divergent effects with different formats (Ballesteros, Reales, & Manga, 2000; Dagleish, 1995; Holle, Neely, & Heimberg, 1997; Jones-Chester, Monsell, & Cooper, 1998; Quero, Banos, & Botella, 2000; Richards, French, Johnson, Naparstek, & Williams, 1992; Waters & Feyerabend, 2000; but see Kaspi, McNally, & Amir, 1995; Cassiday, McNally, & Zeitlin, 1992). In particular, Holle et al. (1997), Jones-Chester et al. (1998), Richards et al. (1992) and Waters and Feyerabend (2000) reported that relevant Stroop effects were larger in the blocked than the mixed format in social phobics, anorexics, high-trait anxious normals and smokers, respectively, even when both formats used computerized presentation.

At a more conceptual level, the blocked and mixed formats might—by design—assess subtly different manifestations of attentional bias. For example, a blocked addiction Stroop might model attentional bias to drug-related cues in a particularly cue-rich environment, such as the scene that confronts a smoker when he or she enters a smoky bar. A mixed addiction Stroop might model attentional bias in an environment in which cues sporadically appear, such as when a smoker periodically encounters people smoking in the street (see similar arguments in Cox, Pothos, Johnson, & Laberg, 2001). In any case, given that the emotional Stroop task is such a widely used indirect measure of emotional processing, and that the different formats are used inter-changeably in the literature, it seems important both to document the psychometric differences between the formats and to understand the psychological processes that underlie the divergent findings.

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