Specific Versus General Accounts of Cognitive Control: Evidence from the Stroop

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Controversy

Cognitive control is the ability of human mind to organize its own cognitive processes. One of the most important debates in the cognitive control research is whether this ability is founded on some general and global cognitive mechanism. It is being proposed (e.g., Koechlin & Summerfield, 2007) that there exists global control, which is involved in most of the situations, and which adapts to the requirements of those situations. However, some authors (e.g., Egner, 2008) provide the evidence that in order to deal with different control problems, the human cognitive system is equipped with many distinct, lowlevel and very specialized control processes, and no general control can be found. Our goal is to investigate this controversy in regard to so-called Stroop interference. Some recent models of the Stroop (van Maanen, et al. 2009) assume a general mechanism underlying both tasks, but appearing at different stages of processing. Contrary to this view, we suspect that these two types of interference may differ qualitatively, especially with regard to the involvement of negative priming.

Research

A total of 81 women and 42 men participated. Seventy people were randomly assigned to the color-word task, and fifty three – to the picture-word task. A total of 80 congruent and 80 incongruent stimuli were applied, in a random order. The independent variables were: the task, the type of a trial (congruent vs. incongruent), and whether a trial was primed (P) or not (N). In primed trials, the distractor feature (a word) from the preceding trial referred to a target feature (a color or a figure, respectively) in a current trial. In non-primed trials a target feature in a current trial was not related to the preceding distractor feature. DV was the mean latency of correct responses directly following a correct response.

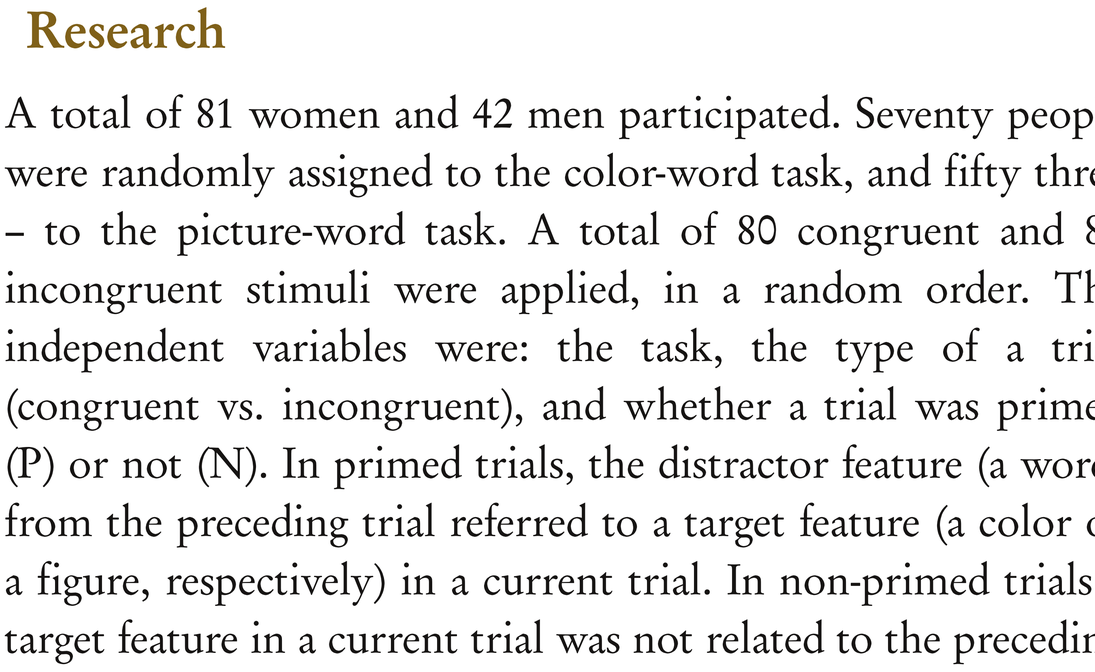

Figure 1. Mean latencies for compared groups.

Results

There was no significant main effect of the task ($F < 1$): participants responded to both task with comparable latency. As could be expected, responses in congruent trials were significantly faster than in incongruent trials (see fig. 1), $F[1, 115] = 26.5$, $p < .001$. The priming effect was also significant, $F[1, 115] = 5.7$, $p = .017$, however the priming entered a two-way interaction with the type of the task, $F[1, 115] = 5.8$, $p = .015$. There was a significant negative priming in the picture-word task, both in congruent (801 vs. 876 ms, in NP vs. P trials, respectively; $p < .001$) and incongruent trials (856 vs. 927 ms, in NP vs. P trials, respectively; $p < .001$). On the contrary, in the color-word task, the differences in mean latencies between P and NP trials were not significant ($ps > .15$), neither in congruent (825 vs. 845 ms, in NP vs. P trials, respectively) nor in incongruent trials (929 vs. 916 ms, in NP vs. P trials, respectively). In each of the tasks, priming selectively affected interference effects. In the color-word task, priming significantly decreased interference, $F[1, 152] = 3.88$, $p = .049$, but it did not yield significant effect ($p > .6$) in the case of the picture-word task.

Discussion

The picture-word task was subject to evident effect of negative priming. This effect was huge (75 ms), as it surpassed the interference effect (53 ms). On the contrary, no priming effect on RTs was observed in the color-word task. The opposite pattern of results regarded the interference effect. It was decreased by priming in the color-word task, but no such an effect was present in the picture-word task. The results support the hypothesis that negative priming, resulting from inhibition of some mental representations, is only present in the picture-word task, probably because only in this task the conflict regards such representations. On the contrary, processing colors in the color-word task probably directly activates respective motor responses, so mean RTs are not affected by priming. However, probably due to some residual response activation, priming had also a positive influence on conflict resolution in that task. Thus, our original work suggests that the color- and picture-word interference effects are not supported by the same general control mechanism, but they represent different and specific conflicts.

References

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