



Attention control and susceptibility to hypnosis

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ABSTRACT

The present work aimed at assessing whether the interference exerted by task-irrelevant spatial information is comparable in high- and low-susceptible individuals and whether it may be eliminated by means of a specific posthypnotic suggestion. To this purpose high- and low-susceptible participants were tested using a Simon-like interference task after the administration of a suggestion aimed at preventing the processing of the irrelevant spatial information conveyed by the stimuli. The suggestion could be administered either in the absence or following a standard hypnotic induction. We showed that, outside from the hypnotic context, the Simon effect was similar in high and low-susceptible participants and it was significantly reduced following the posthypnotic suggestion in high-susceptible participants only. These results show that a specific posthypnotic suggestion can alter information processing in high-susceptible individuals and reduce the interfering effect exerted by arrow stimuli.

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1. Introduction

At any given moment we are confronted with a multitude of environmental inputs, many of which are irrelevant to current behavior. Even though we are normally able to select and limit processing to relevant information – an ability known as attentional control – there are some situations in which irrelevant information cannot be disregarded and influences our behavior independently from our will – a phenomenon known as cognitive conflict.

In laboratory settings, two tasks widely used to study the way we deal with irrelevant information are the Stroop (Stroop, 1935; for a review see MacLeod, 1991) and the flanker tasks (Eriksen & Eriksen, 1974). In the Stroop task, participants are asked to name the ink color of written color words (e.g., the word RED in green ink). To emit the correct response, participants need to select the relevant information (the ink color) and ignore the irrelevant meaning of the word. However, results consistently show that they are unable to do so, being slower and less accurate in naming the ink color of incongruent color words (e.g. BLUE in red ink) than in naming the ink color of congruent color words (e.g. BLUE in blue ink). The most common explanation of the effect is that, since reading is automatic, the irrelevant words are read and, as a consequence, their meaning interferes with color naming.

In the flanker task, introduced by Eriksen and Eriksen (1974), a central target stimulus is presented simultaneously with two distractor stimuli (flankers) that can have the same identity as the target or a different identity and participants are instructed to respond accordingly to the target's identity by pressing one of two keys. To make the correct response, participants need to select the relevant information and inhibit the surrounding irrelevant information (the flankers). Reaction times are typically faster when the flanker letters are congruent with the response assigned to the target letter (e.g. TTT)

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and slower when incongruent (e.g. FTF), thus suggesting that the irrelevant stimuli are not fully excluded from processing. This effect has been interpreted as a failure of focused attention: because of spatial proximity and similarity between target and flankers, attention cannot prevent irrelevant information to access response selection processes.

Interestingly, in high-susceptible individuals – that is individuals who show a high responsivity to hypnosis, as measured by means of standardized scales (e.g., Shore & Orne, 1962; Weitzenhoffer & Hilgard, 1959) – both Stroop and flanker interference can be minimized by means of specific suggestions administered during hypnosis (from now on, posthypnotic suggestions). Specifically, in the case of the Stroop task, there are investigations showing that in high-susceptible individuals the interference exerted by the meaning of the color word can be reduced or even eliminated either by providing attentional focusing instructions (e.g., Nordby, Hugdahl, Jasiukaitis, & Spiegel, 1999; Sheehan, Donovan, & MacLeod, 1988) or by providing specific posthypnotic suggestions to avoid attributing meaning to the color word (Raz, Fan, & Posner, 2005; Raz, Kirsch, Pollard, & Nitkin-Kaner, 2006; Raz, Moreno-Íñiguez, Martin, & Zhu, 2007; Raz, Shapiro, Fan, & Posner, 2002; Raz et al., 2003). In the case of the flanker task, interference can be reduced by means of a posthypnotic suggestion influencing attentional focusing (Iani, Ricci, Gherri, & Rubichi, 2006).

Taken together these results suggest that in high-susceptible individuals attentional control abilities may be enhanced by means of specific posthypnotic suggestions. To note, the idea of a connection between attentional abilities and hypnosis is not new. Indeed, it was first developed in the neuropsychological model of hypnosis proposed by Gruzelier (1988, 1998; see also Crawford, 1994; Crawford & Gruzelier, 1992). According to this model, the process of hypnotic induction consists of three stages characterized by different patterns of brain activation and inhibition and by a different attentional involvement. In the initial stage, attention has to be focused on the hypnotist's voice and distracting information has to be filtered out, a process accompanied by the activation of frontal areas. In the second and third stages, the hypnotic state is reached and attentional functioning is decreased due to inhibition of frontal areas and activation of posterior areas. From this model derive two main predictions. First, high-susceptible subjects should show better baseline attentional functioning compared to low-susceptible subjects. Second, their attentional functioning should be impaired after hypnotic induction.

While the second prediction has been widely confirmed, more debated is whether, outside from the hypnotic context, attentional functioning is more efficient in high-susceptible individuals than in low-susceptible ones. Even though several attentional tasks have been used, we will focus our discussion only on those studies employing the Stroop and flanker paradigms, which specifically test attention control abilities.

As concerns performance after a generic hypnotic induction, there are several studies reporting impaired performance on the Stroop task for high-susceptible individuals (e.g., Blum & Graef, 1971; Egner, Jamieson, & Gruzelier, 2005; Jamieson & Sheehan, 2004; Kaiser, Barker, Haenschel, Baldeweg, & Gruzelier, 1997; Nordby et al., 1999; Sheehan et al., 1988). Neuroimaging investigations have helped to shed some light on the cause of this impairment, showing that in high-susceptible individuals hypnosis disconnects the two main areas involved in handling the conflict, the anterior cingulate cortex (ACC), and the lateral prefrontal cortex (LPFC). There are indications that the ACC serves as a conflict detection mechanism, while the LPFC is thought to implement cognitive control, by sending the appropriate signals to posterior areas once it receives inputs from the ACC (e.g., Stürmer, Redlich, Irlbacher, & Brandt, 2007). By assessing activity levels in the ACC and LPFC areas while high- and low-susceptible participants performed the Stroop task, Egner et al. (2005) found that after hypnotic induction neural activity in the ACC was higher for high-susceptible participants compared to both baseline and low-susceptible participants. Surprisingly, this higher activity was not accompanied by increased activity in the LPFC.

As for attention functioning outside from hypnosis, the results are controversial. We are aware of only two studies employing the flanker task and they both report no difference between high- and low-susceptible individuals (e.g., Castelli, D'Alessandro, & Sebastiani, 2007; Iani et al., 2006). The picture emerging when the Stroop task is considered is much more complex. Indeed, while Egner et al. (2005) found no difference between high- and low-susceptible subjects, there are some reports of larger Stroop interference in high-susceptible individuals (e.g., Dixon, Brunet, & Laurence, 1990; Dixon & Laurence, 1992). In contrast to these results, using a slightly different paradigm and measuring accuracy instead of response times, Rubichi, Ricci, Padovani, and Scaglietti (2005) found a smaller Stroop interference effect in high-susceptible than in low-susceptible individuals and a negative correlation between amount of interference and level of susceptibility. Interestingly, recent studies assessing the relation between susceptibility and genotype found that individuals carrying the valine/methionine Catechol-O-Methyltransferase (COMT) genotype scored higher on standardized hypnotic susceptibility scales compared to individuals carrying the valine/valine genotype (e.g., Lichtenberg, Bachner-Melman, Ebstein, & Crawford, 2004; Lichtenberg, Bachner-Melman, Gritsenko, & Ebstein, 2000; Raz, Fan, & Posner, 2006) and to individuals carrying the methionine/methionine genotype (Raz et al., 2006). This clear-cut pattern of differences was, however, not completely replicated in a study assessing the relation between COMT genotypes and Stroop performance (e.g., Sommer, Fossella, Fan, & Posner, 2003).

These contrasting results can be taken as an indication that the relation between susceptibility and attention may be subtle and that, as acknowledged by Rubichi et al. (2005), more sensitive tasks may be necessary to detect differences between high- and low-susceptible individuals. Another task that can be used for exploring differences in the ability of participants to ignore irrelevant information and handle conflicts between competing task dimensions is the Simon task (Simon & Rudell, 1967; for a review, see Proctor & Vu, 2006). In this paradigm participants are required to respond to a non-spatial stimulus feature (e.g., stimulus color or shape) by pressing a spatially-defined response (e.g., a left or right response key). Even though stimulus location is completely irrelevant for performing the task, responses are faster and more accurate when stimulus and response position correspond (corresponding trials), compared to when they do not

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