



Hypnotic suggestibility predicts the magnitude of the imaginative word blindness suggestion effect in a non-hypnotic context



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ABSTRACT

The present study investigated how the magnitude the word blindness suggestion effect on Stroop interference depended on hypnotic suggestibility when given as an *imaginative* suggestion (i.e. not post-hypnotic suggestion) and under conditions in which hypnosis was not mentioned. Hypnotic suggestibility is shown to be a significant predictor of the magnitude of the imaginative word blindness suggestion effect under these conditions. This is therefore the first study to show a linear relationship between the imaginative word blindness suggestion effect and hypnotic suggestibility across the whole hypnotizability spectrum. The results replicate previous findings showing that highs respond to the word blindness suggestion to a greater extent than lows but extend previous work by showing that the advantage for those higher on the hypnotizability spectrum occurs even in a non-hypnotic context. Negative attitudes about hypnosis may not explain the failure to observe similar effects of the word blindness suggestion in less hypnotizable individuals.

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1. Introduction

Highly hypnotizable individuals (henceforth highs) are able to create distortions in attention and perception in ways we do not yet fully understand. For example, a commonly used test of attention is the Stroop effect (see MacLeod, 1992). The Stroop effect refers to the finding that, compared to a baseline condition, participants take longer to respond to the colour of the font in which a word is presented when that word is incongruent to the colour. Raz, Shapiro, Fan, and Posner (2002) showed that highs given a post-hypnotic suggestion that words would appear meaningless showed a dramatically reduced Stroop effect. So how can highs overcome one of the most habitual responses we have, namely reading a word? Is this ability unique to highs, or does it rely on a strategy anybody can adopt? One view of highs is that they have special abilities not available to others, for example abilities to dissociate (Hilgard, 1977) or to attend (Crawford, Brown, & Moon, 1993) that vary across the hypnotic suggestibility spectrum. Another view is that highs differ from less hypnotizable individuals largely or entirely in attitudes, beliefs and expectations (Kirsch, 1985; Spanos, 1986; see Heap, Brown, & Oakley, 2004 for a review of research on hypnotisability). On the former view, highs would be able to reduce Stroop effects in a way not available to less hypnotizable individuals. On the latter view, less hypnotizable individuals should be able to reduce the Stroop effect just as well as highs if the influence of attitudes, beliefs and expectations can be lessened.

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Raz and Campbell (2011) went some way to answering this question when they showed the effect of the post-hypnotic word blindness suggestion was significantly greater in highs rather than lows. Critically, the suggestion resulted in a reduction in Stroop interference in lows of about 40 ms, which was roughly half that observed in highs. Thus, there at least appears to be a difference between highs and lows in overcoming the Stroop effect by attempting to see words as meaningless when the word blindness suggestion is given as a post-hypnotic suggestion. Furthermore, in a recent study Parris, Dienes, Bate, and Gothard (in press) showed a 34 ms effect of the post-hypnotic word blindness suggestion on Stroop interference in the often ignored group of medium hypnotizable individuals. Parris et al. assessed the effect of the neuropeptide oxytocin on the post-hypnotic word blindness suggestion in a double blind randomized placebo-controlled study in two groups of medium hypnotizable individuals so there was no data comparing mediums to groups with differing levels of hypnotic suggestibility. (Nevertheless, the effect size is numerically smaller than the 48 ms effect observed in highly hypnotizable individuals by the same research group, Parris, Dienes, and Hodgson (2012).) It is possible that less hypnotizable individuals may perform badly in situations defined as hypnotic purely because they have negative attitudes about hypnosis (Spanos, 1986). That is, a relation between a task performance and hypnotic suggestibility may only arise when the context is defined as hypnotic.

Context has been shown to be important in determining the relationship between hypnotic suggestibility and personality or cognitive variables (e.g. Council, Kirsch, & Hafner, 1986; Stam & Spanos, 1980; see also Spanos, 1986). Council et al. (1986) showed that the personality trait absorption was only related to hypnotic suggestibility in the hypnotic context. They concluded that completing the absorption questionnaire altered expectancies about responsiveness to hypnotic test suggestions, and these altered expectancies then determined hypnotic behaviour (although see Lifshitz, Howells, & Raz, 2012, for contrary evidence as to the role of expectancies in responsiveness to suggestions). Whilst some theorists posit that hypnotic suggestibility is a stable trait and thus largely immutable to attitudes and expectations (Kihlstrom, 2003; Tellegen & Atkinson, 1974), there is substantial evidence to the contrary (see Lynn, Kirsch, & Hallquist, 2008, for a review), raising the possibility that the effect of the word blindness suggestion is also modulated, at least to some extent, by attitudes and expectations (cf. Magalhães De Saldanha da Gama, Slama, Caspar, Gevers, & Cleeremans, in press, who show expectations can modulate the Stroop effect).

Showing the effectiveness of imagination alone in responding to the word blindness suggestion, Raz, Kirsch, Pollard, and Nitkin-Kaner (2006) found no difference in the effects of the post-hypnotic and imaginative word blindness suggestion in highs, but did not test the performance of less hypnotizable individuals. This raises the question of whether less hypnotizable individuals would do as well as highs do in the (non-hypnotic) context of an exercise of using their imagination. To test this possibility, we sought to establish if there was a relationship between hypnotic suggestibility and the effect of the word blindness suggestion out of the hypnotic context.

Raz et al. (2006) is the only paper showing the effectiveness of imagination alone in operationalising the word blindness suggestion. It is therefore important to replicate the effectiveness of imagination in producing the word blindness suggestion. Moreover, in Raz et al.'s (2006) study it is not clear whether attempts were made in the imaginative suggestion condition to remove any mention or indication of hypnosis. The need for a replication of the effectiveness of imagination in producing the word blindness suggestion effect is further highlighted by contrasting results in similar selective attention tasks. For example, Iani, Ricci, Gherri, and Rubichi (2006) showed that whilst a post-hypnotic suggestion effectively eliminated the Flanker Compatibility Effect in highs, the imaginative suggestion had no such effect. The same pattern of results was observed by Iani, Ricci, Baroni, and Rubichi (2009) using the Simon task.

The aim of the present study was to investigate whether the imaginative word blindness suggestion can reduce Stroop effects in a context that is unrelated to hypnosis and to identify whether, if successful, there is a relationship between hypnotic suggestibility and the effect of the suggestion. To that end, participants were invited to participate in a study referred to as a study of the effect of imagination on cognitive tasks. They were recruited from a pool of participants screened using the Waterloo-Stanford Scale earlier in the academic year, with a different experimenter, in a different lab, who made no mention of hypnosis at any time. A response-stimulus interval (RSI) manipulation was also included since Parris et al. (2012) showed that the suggestion effect is stronger when RSI is 500 ms compared to the 3500 ms employed by Raz and colleagues, though both RSI conditions allow substantial post-hypnotic suggestion effects (Parris, Dienes, & Hodgson, submitted for publication).

2. Method

2.1. Participants

One hundred participants were screened using the Waterloo-Stanford Group Scale of Hypnotic Susceptibility, Form C (Bowers, 1993) at the University of Sussex for this experiment. The age regression challenge was not included making the scale out of 11. From this cohort, 11 low (scoring 0–3), 13 medium (scoring 4–7) and 11 high suggestible participants (scoring 8–11) were recruited. The 35 (10 males) students were aged 25.5 years ($SD = 4.02$).

2.2. Materials

All aspects of the materials, design and procedure matched those of Raz et al. (2002) as closely as possible. The colours red, blue, yellow and green were used in the experiment. The incongruent stimuli consisted of the words RED, BLUE, YELLOW or GREEN presented equally often in any of the three non-matching colours (e.g. The word red was presented in blue, yellow

or green). The congruent stimuli consisted of the words RED, BLUE, YELLOW or GREEN presented in red, blue yellow and green, respectively. The neutral stimuli were matched to the colour word stimuli for word length and frequency and consisted of the words LOT, SHIP, KNIFE and FLOWER presented in any one of the four colours. All characters were displayed in upper-case font against a white background, and the stimuli subtended visual angles of 0.5° vertically, and 1.3–1.9° horizontally (depending on word length). Red, blue, yellow and green colour patches were placed on the “V”, “B”, “N” and “M” keys, respectively and participants were asked to use the index and middle fingers from each hand to respond.

2.3. Design and procedure

Importantly participants had no prior knowledge that a suggestion would be given, or that the experiment was related to hypnosis in any way, and they believed that the aim of the experiment was to investigate the effect of imagination on an array of cognitive tasks. The experimental design was a mixed factorial model with congruency (incongruent, neutral, congruent), response-stimulus interval (500 ms, 3500 ms), and imaginative suggestion (absent, present) as within-subjects factors. Administration order of both the RSI and suggestion conditions was counterbalanced such that a quarter of the participants did the short RSI, suggestion present condition first, followed by the long RSI, suggestion present condition and then the long RSI, suggestion absent condition, followed by the short RSI, suggestion absent condition; a quarter of the participants did the long RSI, suggestion present condition first, followed by the short RSI, suggestion present condition and then the short RSI, suggestion absent condition, followed by the long RSI, suggestion absent condition. The administration order for the two levels of the RSI factor was counterbalanced in the same way for the remaining two quarters of participants but they did the suggestion absent condition first. Participants were given a 10-min break between the suggestion present and absent conditions.

Participants were told that an imagination task would be administered at a certain point during the experiment. They were asked to sign a consent form and told that in a while they would be asked to play a computer game (i.e. the Stroop task). The RSI conditions were presented in blocks consisting of 144 trials each. Of the 144 trials, 48 were congruent, 48 neutral and 48 incongruent which were intermixed and presented random order. At the beginning of the testing session participants were given 36 practical trials which consisted of 12 of each word type and had an RSI of 2000 ms. The first trial of each block began with a fixation cross at the centre of the screen that remained on screen for the duration of the response-stimulus-interval for the block (500 ms or 3500 ms). The stimulus remained onscreen until response. After each response, visual feedback was present stating whether their previous response was “CORRECT” or “INCORRECT”. The feedback was presented in black ink for 100 ms and was replaced by a fixation cross for the remainder of the RSI. In the suggestion absent condition participants were asked to respond as quickly and accurately as possible to the colour of the stimulus whilst ignoring the meaning of the presented word. In the suggestion present condition the participants were given the following imaginative suggestion:

Previous research has shown that people with high levels of imaginative ability can change the way they see the world, if they so choose; an ability they can find surprising. We are going to explore that natural ability now. Very soon you will be playing the computer game. When I clap my hands, meaningless symbols will appear in the middle of the screen. They will feel like characters of a foreign language that you do not know, and you will not attempt to attribute any meaning to them. This gibberish will be printed in one of 4 ink colours: red, blue, green or yellow. Although you will only be able to attend to the symbols' ink colour, you will look straight at the scrambled signs and crisply see all of them. Your job is to quickly and accurately depress the key that corresponds to the ink colour shown. You will find that you can play this game easily and effortlessly.

3. Results

3.1. Analysis of RTs

To be consistent with previous studies before being entered into analysis, the data from correct trials were subjected to an outlier removal procedure based on that used by Raz, Shapiro, Fan, and Posner (2002), Raz, Kirsch, Pollard, and Nitkin-Kaner (2006) and Raz and Campbell (2011). Trials on which RTs were 3 SDs either above or below the mean were excluded from the analysis which resulted in 4.6% of the trials being removed from the analysis. See Table 1 for reaction times and the percentage of errors committed as a function of hypnotic suggestibility and condition.

Before testing for the relationship between hypnotic suggestibility and the effect of the suggestion on interference we first considered whether there was an effect of the response-stimulus interval manipulation on interference (see Parris, Dienes, & Hodgson, submitted for publication). A paired-samples *t*-test comparing the suggestion effect (the Stroop interference effect in the suggestion present condition subtracted from that in the suggestion absent condition) in the long (mean = 16.5 ms, SE = 12.2 ms) and short (mean = 2.2 ms, SE = 13.2 ms) RSI conditions was not significant where $t(34) = .986, p > .3$. Furthermore, we regressed the difference between the suggestion effect in the two RSI conditions on hypnotic suggestibility, which yielded a non-significant result ($b = .027, t(33) = .156, p > .8$); that is, there was not a significant interaction between RSI and hypnotic suggestibility in predicting the suggestion effect. For this reason, all further analyses were collapsed across RSI.

Table 1

Mean reaction times (milliseconds) and errors (%) with standard deviations in brackets, and magnitudes of interference (incongruent-neutral) and facilitation (neutral-congruent) for highs (scoring between 8 and 11 on the Waterloo-Stanford Scale), mediums (scoring between 4 and 7) and lows (scoring between 0 and 3) when the imaginative word blindness suggestion was both present and absent.

	Highs		Mediums		Lows	
	Suggestion present	Suggestion absent	Suggestion present	Suggestion absent	Suggestion present	Suggestion absent
<i>Reaction times (ms)</i>						
Incongruent	795 (212)	861 (151)	772 (109)	816 (174)	826 (88)	801 (114)
Neutral	757 (214)	770 (136)	738 (116)	761 (141)	764 (69)	750 (98)
Congruent	750 (195)	754 (120)	705 (94)	739 (147)	751 (80)	738 (89)
Interference	38	91	34	55	62	51
Facilitation	7	16	33	22	14	12
<i>Errors (%)</i>						
Incongruent	9.5 (9.3)	8.2 (6.3)	5.4 (5.2)	5.3 (4.5)	3.6 (3)	3.9 (3.8)
Neutral	8.1 (5.4)	6.3 (5.8)	4.7 (4.7)	3.4 (5.2)	2.9 (3.7)	3.4 (3.1)
Congruent	7 (6.6)	4.8 (3.8)	3.1 (3.9)	3.8 (2.9)	2.6 (2.3)	3.1 (2.8)
Interference	1.4	1.9	0.7	1.9	0.7	0.4
Facilitation	1.1	1.5	1.6	-0.4	0.3	0.3

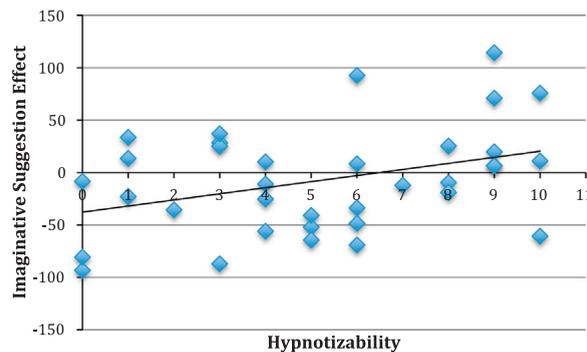


Fig. 1. The relationship between the effect of the imaginative suggestion on Stroop interference (incongruent-neutral) and hypnotic suggestibility.

Fig. 1 shows the relation between the effect of the imaginative suggestion plotted against hypnotic suggestibility. Critically, the overall effect of the suggestion on interference regressed on hypnotic suggestibility was significant, where $b = .366$, $t(33) = 2.261$, $p = .030$. The intercept was -37.7 ($SE = 15.712$, $t(33) = 2.399$, $p = .022$) indicating not a reduction, but an increase, in interference for subjects with the lowest hypnotic suggestibility. A regression testing for a quadratic relationship between the effect of suggestion on interference and hypnotic suggestibility was non-significant ($b = .097$, $t(33) = .589$, $p > .5$). The latter non-significant result is consistent either with evidence for no relationship or simply with the absence of evidence for a relationship. Given that understanding the nature of the relationship between the imaginative word blindness suggestion effect and hypnotic suggestibility was a key aim of the paper we set out to determine if there was no evidence for quadratic relationship, we used a novel application of the Bayes Factor to analysing trends, where we contrasted the theory of a quadratic relationship with the null hypothesis of no quadratic relationship. The Bayes Factor was .97 indicating the evidence was insensitive in distinguishing the hypothesis of a quadratic from the null hypothesis (.33 and below being the cut off for strong evidence for the null, Dienes (2011)). That is, there is not strong evidence that there was no quadratic relationship of hypnotic suggestibility on the suggestion effect on interference.¹

Few previous studies have observed an effect of the word blindness suggestion on Stroop facilitation. Testing for linear and quadratic relationships between the effect of the suggestion on Stroop facilitation and hypnotic suggestibility yielded non-significant results ($b = .052$, $t(32) = .301$, $p > .7$ and $b = -.084$, $t(32) = -.476$, $p > .6$, respectively).

¹ We modelled the predictions of the theory of an absence of evidence for a relationship with a uniform whose maximum and minimum were created by obtaining the lowest and highest plausible values for the quadratic slope. To obtain the lowest plausible quadratic slope, highs and mediums were assumed to be identical in terms of the effect of the word blindness suggestion on Stroop interference (so a variable was created where the mean suggestion effect of the highs was assigned to all the highs and mediums) whereas the lows were assumed to be different (the mean suggestion effect for the lows was used for all lows). To obtain the highest plausible quadratic slope, highs were assumed to be different and mediums and lows were assumed to be identical (thus a second variable was created with the mean effect for highs assigned to all highs, and the mean effect for lows assigned to all mediums and lows). After constructing these variables of scores giving the extreme quadratic effects consistent with our data we regressed each column on Hypnotic suggestibility. The resulting regression slopes were used as the lower and upper bounds of a uniform representing the predictions of the theory that there was a quadratic effect. The minimum was -0.673 and the maximum was 0.908 .

Finally, our data allow us to address whether hypnotic suggestibility determines the magnitude of the Stroop effect when participants are not under the influence of a suggestion or in a hypnotic context. The majority of findings indicate no relationship between the two variables, despite utilising a variety of methods (Aikins & Ray, 2001; Egner, Jamieson, & Gruzelier, 2005; Kaiser, Barker, Haenschel, Baldeweg, & Gruzelier, 1997; Kallio, Revonsuo, Hämäläinen, Markela, & Gruzelier, 2001; Jamieson & Sheehan, 2004; Raz & Campbell, 2011; Raz, Fan, & Posner, 2005; Raz et al., 2002, 2003; Sheehan, Donovan, & MacLeod, 1988), but some studies have demonstrated poorer performance in highs (Dixon, Brunet, & Laurence, 1990; Dixon & Laurence, 1992) and one study better performance in highs (Rubichi, Ricci, Padovani, & Scaglietti, 2005). In our data, we did not observe a significant relationship between hypnotic suggestibility and Stroop interference ($b = .219$, $t(33) = 1.290$, $p > .2$) or Stroop facilitation ($b = -.027$, $t(33) = .154$, $p > .8$). Moreover, no significant quadratic relationship between these variables was found ($b = .118$, $t(32) = 1.290$, $p > .2$).

3.2. Analysis of errors

Analysis revealed no significant effects in the error data. There was no significant relationship between hypnotic suggestibility and: (1) Stroop interference in the suggestion absent condition ($b = .140$, $t(33) = .811$, $p > .4$); (2) Stroop facilitation in the suggestion absent condition ($b = .155$, $t(33) = .901$, $p > .3$); (3) Stroop interference in the suggestion present condition ($b = .168$, $t(33) = .982$, $p > .4$); (4) Stroop facilitation in the suggestion present condition ($b = .058$, $t(33) = .334$, $p > .7$); (5) The suggestion effect on interference ($b = .024$, $t(33) = .137$, $p > .8$); (6) The suggestion effect on facilitation ($b = .102$, $t(33) = .589$, $p > .5$).

4. Discussion

The results from this experiment showed that the word blindness suggestion, when given as an imaginative suggestion in experimental conditions that make no direct reference to hypnosis, results in a greater reduction in Stroop interference in higher rather than less hypnotizable individuals. This study is the first to show a linear relationship between the imaginative word blindness suggestion and hypnotic suggestibility across the whole hypnotic suggestibility spectrum. The results replicate previous findings showing that highs respond to the word blindness suggestion to a greater extent than lows (Raz & Campbell, 2011), but we extend previous work in showing that the advantage of highs still occurs even in a non-hypnotic context; a finding suggesting that negative attitudes about hypnosis do not fully account for the failure to observe similar effects of the word blindness suggestion in less hypnotizable individuals (Spanos, 1986). Indeed, the reduction in Stroop interference in the present study for highs was 53 ms, numerically higher than the reduction of 22 ms we achieved with the same paradigm but a posthypnotic rather than imaginative suggestion in Parris et al. (2012).

The replication of the imaginative word blindness suggestion effect is important given findings from other labs showing no effect of imaginative suggestions on performance of the Erikson flanker task and the Simon task (Iani et al., 2006, 2009, respectively). In both studies, Iani and colleagues argued that the hypnotic context was necessary for their suggestions to work since they showed a significant effect of a post-hypnotic word blindness suggestion. Iani et al. (2009) noted that conflict in the Simon and Stroop tasks arises at different points in the response process with conflict arising between the irrelevant stimulus dimension and the response in the Simon task and between irrelevant and relevant stimulus dimensions in the Stroop task. It might be that imaginative suggestions are not capable of influencing the type of conflict experienced in the Simon task (see Kornblum, Hasbroucq, & Osman, 1990). However, the imaginative suggestion was not worded identically to the post-hypnotic suggestion in the Iani et al. (2006) study. Notably, in the Iani et al. papers, the compatibility effects are overcome by overall slowing down of RTs in the suggestion compared to the non-suggestion condition, a process that allows an explanation in terms of demand characteristics (i.e. knowing that suggestion is “meant” to reduce differences between conditions), especially when imaginative and hypnotic suggestions are not matched for exact content (cf. Iani et al., 2006) so there exist demands for greater response in the hypnosis condition.

To the extent that we achieved the desired effect of removing the hypnotic context and associated attitudes and expectations, our results indicate that the failure to observe similar effects of the word blindness suggestion in those varying in hypnotic suggestibility is unlikely to be related to differences in attitudes and expectations. The observed relationship is instead indicative of a difference in ability to respond to suggestions (Kihlstrom, 2003; Tellegen & Atkinson, 1974). One caveat is that although we removed the hypnotic context and made every effort to remove mention of hypnosis or suggestion leading up to participation, the delivery of the suggestion itself may have primed attitudes and expectations related to hypnosis and suggestion. This possibility is supported by the finding of a significant negative effect of the suggestion at the intercept; thus for a hypnotic suggestibility score of zero Stroop interference actually increased after the suggestion was delivered. However, given our study’s focus on the use of imagination in the instructions given and overall context it is equally likely that the use of imaginative strategies did not come easily to these participants, which means extra demands on resources when attempting unsuccessfully to marshal the necessary control over automatic cognitive processes. Such a possibility is consistent with the finding that greater Stroop interference results in those with lower working memory capacity (e.g. Kane & Engle, 2003). Future assays could consider increasing expectations of an effect in less hypnotizable individuals (e.g. Spanos, 1986), although showing that less hypnotizable individuals can achieve effects of similar magnitudes when appropriately motivated, is not evidence of the employment of identical strategies or skills (Rosenthal, 1986). Further, we

did not measure expectations or attitudes toward the imaginative suggestion, and this remains an important task for future research.

Lifshitz, Aubert-Bonn, Fischer, Kasham, and Raz (2013) have recently argued that effects such as the word blindness suggestion effect are evidence of the deautomatization of cognitive processes; a notion that blurs the traditional distinction between controlled and automatic processing (see also Parris, Bate, Brown, & Hodgson, 2012; Verbruggen & Logan, 2009). Together with previous work our results support the notion that the capacity to achieve the apparent deautomatization of behaviour is present within most people, but to greater and lesser extents. What abilities do those higher on the hypnotic suggestibility spectrum have that enable them to overcome an automatic process to a greater extent than less hypnotizable individuals? It cannot simply be because highs are, say, better at executive control than lows, because highs are no better than lows at the Stroop test when no suggestion is given as evidenced by the present results and previous studies (Aikins & Ray, 2001; Egner et al., 2005; Kaiser et al., 1997; Kallio et al., 2001; Jamieson & Sheehan, 2004; Raz & Campbell, 2011; Raz, Landzberg, Schweizer, Zephrani, Shapiro, & Fan et al., 2003; Raz et al., 2002, 2005; Sheehan et al., 1988). In terms of inhibitory abilities more generally, Dienes et al. (2009) found with 180 participants in a non-hypnotic context, and without suggestion, the correlations between hypnotic suggestibility and measures of inhibition including a latent inhibition task, a spatial negative priming task and a memory task designed to measure negative priming were close to zero, with upper limits of about 0.20. Similarly, Varga, Németh, and Székely (2011) with 116 subjects found no significant correlations between hypnotisability and reaction time measures of sustained, selective, divided or executive attention (see Crawford et al., 1993, for the argument for a relationship between hypnotisability and attentional ability). What cognitive mechanisms are those higher on the hypnotic suggestibility spectrum able to bring to bear on overcoming Stroop interference when specifically given the word blindness suggestion (in a context defined as hypnotic or just imaginative) remains a mystery for future research. References to dissociation (Woody & Sadler, 2008), or the ability of highs to engage strategically in an unconscious way (Barnier, Dienes, & Mitchell, 2008; Dienes, 2012; Dienes & Perner, 2007) or in response to demand characteristics (Spanos, 1986) do not, as of yet, resolve the problem.

To conclude, we have shown that the word blindness suggestion is effective when given as an imaginative suggestion in conditions unrelated to hypnosis. Furthermore, the effect of the imaginative suggestion was greater for those higher on the hypnotic suggestibility spectrum, even when experimental conditions were favourable to the observance of an effect in those with negative attitudes towards hypnosis.

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