



Subliminal understanding of negation: Unconscious control by subliminal processing of word pairs



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ABSTRACT

A series of five experiments investigated the extent of subliminal processing of negation. Participants were presented with a subliminal instruction to either *pick* or *not pick* an accompanying noun, followed by a choice of two nouns. By employing subjective measures to determine individual thresholds of subliminal priming, the results of these studies indicated that participants were able to identify the correct noun of the pair – even when the correct noun was specified by negation. Furthermore, using a grey-scale contrast method of masking, Experiment 5 confirmed that these priming effects were evidenced in the absence of partial awareness, and without the effect being attributed to the retrieval of stimulus–response links established during conscious rehearsal.

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1. Introduction

Just how much information and knowledge can be acquired through subliminal perception, or just how intelligent unconscious cognitive processing is, remains a familiar and controversial theme (Greenwald, 1992; Norman, 2010). In a classic priming experiment, subjects are briefly presented with a word, or prime, that is prevented from entering conscious perception through the use of a forward or backward mask. When subsequently presented with a further target word, participants are quicker to categorise the target if both the prime and target are semantically related. Whilst the unconscious analysis of letters is more sophisticated than the analysis of individual lines or angles, the semantic analysis of subliminal words or even multiple word-strings would indicate a far more intelligent and sophisticated interpretation of ‘unconscious cognition’ (Loftus & Klinger, 1992). Evidence suggests that the subliminal presentation of a word facilitates lexical and semantic access (e.g., Abad, Noguera, & Ortells, 2003; Carr & Dagenbach, 1990; Dell’Acqua & Grainger, 1999; Forster & Davis, 1984; Fowler, Wolford, Slade, & Tassinari, 1981; Gaillard et al., 2006; Marcel, 1983; Ortells, Daza, & Fox, 2003), although the precise interpretation of these results will be addressed below.

Subliminal psychodynamic activation (SPA) studies offer evidence of some of the most sophisticated subliminal priming effects, apparently demonstrating the semantic analysis of multiple word primes (Bronstein & Rodin, 1983; Nissenfeld, 1979; Silverman, Ross, Adler, & Lustig, 1978; Silverman & Weinberger, 1985; Waller & Barter, 2005). However, SPA studies have been heavily criticised by others that have tried and failed to replicate results (Allen & Condon, 1982; Condon & Allen, 1980; Heilbrun, 1980). Furthermore, whatever the replicability of the results, given that the sentences used differ in the specific words used, any effect evidenced may instead be attributable to simple single-word priming. In fact, there still exists controversy regarding whether or not the semantic analysis of subliminal primes even occurs (Abrams & Greenwald, 2000; Damian, 2001; Hutchison, Neely, Neill, & Walker, 2004; Kouider & Dupoux, 2004). In an article investigating the extent

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of unconscious cognition, Greenwald (1992) argued that unconscious cognitive processing is far less sophisticated in its analytical capabilities than is often reported. Greenwald's (1992) argument rests on the premise that additional research has demonstrated unconscious analysis and processing of nothing more elaborate than word fragments.

As an example, Abrams and Greenwald (2000) required participants to categorise a set of consciously perceived 'parent' primes as either positive or negative in valence. Participants were subsequently required to categorise a set of subliminally perceived 'hulip-type hybrid primes', a non-word hybrid of two positive or two negative parent primes (e.g., humour–tulip–hulip, smut–bile–biut). Results indicated that participants were successfully able to categorise emotional valence despite the nonsensical nature of the hybrid primes. In a follow up study, having consciously categorised parent primes, participants were required to positively or negatively categorise a set of so called 'tumour-type hybrid primes'. These primes were similarly created by combining two congruent parent primes to create a semantically comprehensible prime of different valence to parent primes (e.g. humour–tulip–tumour, smut–bile–smile). Results indicated that participants continued to classify emotional valence according to the valence of the parent prime rather than tumour-type prime, even to the extent that 'smile' was categorised as negative. The results of this study compellingly suggest that words are analysed at the level of (consciously primed) word-parts as opposed to whole-word meaning.

However, Sklar et al. (2012) have suggested that subliminal processing may have appeared limited in past research because of the small time windows that processing is given for backward masked stimuli (typically in the order of 30 ms). Their solution was to use continuous flash suppression, maintaining stimuli as subliminal for as long as 2 s. Impressively, they found that semantically incoherent sentences (e.g., "The bench ate a zebra") broke through suppression faster than coherent sentences (e.g. "The lion ate a zebra"). However, as with SPA studies, there may have been a word-level effect influencing breakthrough as literally different words were used in the different conditions (in this example, "bench" versus "lion"). In a second series of experiments, they found that three-term subtractions (e.g. 9–3–4) (though not additions) primed the speed of pronunciation of the subsequent correct answer. In neither the sentence coherence nor three-term subtraction experiments did the stimuli constitute obvious "set phrases" that may have been previously well learnt as a unit.

These results raise the question of what sort of combinations of stimuli are possible to process subliminally. For example, Van Opstal, Gevers, Osman and Verguts (2010) demonstrated that a same/different judgement task on consciously perceived number targets (e.g., 1–1 or 1–3) extended to subliminal letter stimuli (e.g., a–A or a–D) even when participants were unaware of the presence of the letters. Van Opstal, Calderon, Gevers and Verguts (2011) extended this finding by demonstrating that responding to the subliminal same/different judgements (e.g., a–A) could be modulated by unconscious context (e.g., either a–a or a–D). Therefore, priming effects were dependent upon the processing of both elements. We similarly wished to demonstrate semantic priming of two-element (word) primes and unconscious cognitive control by investigating whether it is possible to process instructions to exclude (i.e., negation) subliminally. As we will discuss, negation has a special place in consciousness research.

The use of negation allows easy control of stimuli, because stimuli can consist of the same words, just with or without "not". The use of negation also addresses one of the theoretical limits assigned to unconscious processes. According to Jacoby, Lindsay, and Toth (1992), what the conscious is uniquely equipped to do is control behaviour by excluding certain responses. Unconscious control exerted by subliminal stimuli was investigated by, for example, Lau and Passingham (2007), in which a subliminal shape indicated which of two tasks to perform; and by van Gaal, Ridderinkhof, Scholte, and Lamme (2010), in which a subliminal no-go cue slowed down responses and activated a frontal-parietal inhibition network (see van Gaal, de Lange, & Cohen, 2012, for a review of related work). Van den Bussche, Segers, and Reynvoet (2008) indicated limits to unconscious control in that the proportion of conscious stimuli could be used to modulate responding but not the proportion of subliminal stimuli. In contrast to previous studies that have looked at subliminal control, we will be exploring it in the specific case of linguistic negation processing. Although not dealing with linguistic negation, the previous work is encouraging in showing that there exists a mechanism by which unconscious control could operate. In this respect, the current work is consistent with Dienes and Perner's (2007) cold control theory of hypnosis, which postulates that hypnosis consists of unconscious executive control. It is also consistent with the findings of, for example, Norman, Price, and Jones (2011) and Wan, Dienes, and Fu (2008), who showed people could exert control over the use of structural knowledge, even when it was unconscious. That is, while the processing of subliminal linguistic negation has not been shown, it is plausible that the unconscious can deal with control and exclusion. Thus, the subliminal processing of negation in two-word phrases presents itself as possible on those theories that allow unconscious control (contrast Jacoby et al.), but beyond what has so far been shown to occur subliminally.

The present set of studies attempted to assess whether, contrary to Abrams and Greenwald (2000), subliminal perception is sensitive to the semantic comprehension of word combinations and sentence structure. In summing up his argument against complex unconscious cognition, Greenwald (1992) issued an empirical two-word challenge. This two-word challenge asserts that to demonstrate successful subliminal priming of two-word primes, neither word should individually impart the final meaning. Therefore, to claim successful unconscious processing of multiple words, each word would need to be individually processed. The present experiments aimed to meet this challenge by presenting participants with a two word instruction, instructing them which of two subsequent words to choose. Therefore, performance would depend on the successful semantic processing of both words.

One explanation to account for the failure of many studies to demonstrate successful subliminal semantic activation of single or multiple word primes may be due to the adherence to strict objective thresholds using backward masking when measuring subliminality. Objective methods of assessing unconscious cognition presume that trial accuracy, beyond what

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