Consciousness and Cognition 29 (2014) 230–234

Contents lists available at ScienceDirect

Consciousness and Cognition

journal homepage: www.elsevier.com/locate/concog

Subliminal primes for global or local processing influence judgments of vehicular traffic

Stefanie Hüttermann [a,*], Otmar Bock [b], Daniel Memmert [a]

[a] Institute of Cognitive and Team/Racket Sport Research, German Sport University Cologne, Germany
[b] Institute of Physiology and Anatomy, German Sport University Cologne, Germany

ARTICLE INFO

Article history:
Received 13 January 2014

Keywords:
Subliminal priming
Attentional breadth
Local attention
Global attention

ABSTRACT

Previous studies on semantic priming show that briefly presented words can unconsciously manipulate subjects' mental states, behaviors, and attitudes. Here we evaluated whether semantic primes can also manipulate the breadth of subjects' visual attention. We primed participants with briefly presented words that indicate either broadness or narrowness; each prime was followed by either a large or a small picture of a street intersection with vehicles, and participants had to indicate in which order the vehicles were legally allowed to pass the intersection. Participants responded to large pictures faster when primed with words denoting broadness, and to small pictures faster when primed with words denoting narrowness. From this we concluded that semantic priming can be effectively applied to manipulate the breadth of attention, which could be exploited in real-world scenarios.

1. Introduction

In everyday life, we often have to distribute our attention across our whole visual field while at other times it must be merely focused on a limited area of space (Nideffer, 1976). It is well-established that humans can flexibly change between global and local attention (e.g., Eriksen & St. James, 1986; Kinchla, Solis-Macias, & Hoffman, 1983) in dependence on spatial (e.g., Shulman & Wilson, 1987) and temporal (e.g., Lamb & Yund, 1996) characteristics of a displayed scene but also scene-independent (e.g., Gasper & Clore, 2002). A variety of researchers (e.g., Förster & Higgins, 2005; Förster, Liberman, & Kuschel, 2008; Navon, 1977; Schwarz & Bless, 2007) have documented – mostly by using perceptual tasks – that a person's preference for processing global versus local information can be experimentally manipulated. Our study examined for the first time whether the direction and scope of the attentional focus can be controlled and affected by semantic priming, too.

In recent years, the phenomenon of semantic priming has been proven in an increasing number of studies (for reviews see Hutchison, 2003; Lucas, 2000; Maxfield, 1997). Commonly, prime words were presented so briefly that they escaped subjects' awareness but nevertheless affected their responses to subsequent target words (cf. Meyer & Schvaneveldt, 1971). This finding is typically interpreted as evidence for a lexical network in the brain which stores semantically related information in adjacent locations: a prime word would activate a given location for some time, and thus facilitate the response to a subsequent, semantically congruent target (Collins & Loftus, 1975; Kiesel, Kunde, & Hoffmann, 2007; Klauer & Musch, 2003). In the present study, we experimentally manipulated at the semantic level a person's preference for processing of global versus

* Corresponding author. Address: Institute of Cognitive and Team/Racket Sport Research, German Sport University Cologne, Am Sportpark Müngersdorf 6, 50933 Köln, Germany. Fax: +49 221 4982 8260.
E-mail address: s.huettermann@dshs-koeln.de (S. Hüttermann).

http://dx.doi.org/10.1016/j.concog.2014.08.007
1053-8100/

local information. Participants were primed with words denoting either a wide or a narrow focus (e.g., "universal" or "compressed"). We hypothesized that primes denoting a global or a local focus not only modify the semantic analysis of subsequent words, but also change the subsequent processing of spatially distributed information: priming with words such as "universal" would therefore facilitate the processing of large (congruent condition) rather than small (incongruent condition) visual scenes, while the opposite would hold for priming with words such as "compressed". This means, in sum, we hypothesized that congruent primes would shorten response times and incongruent trials would result in longer response times compared to neutral primes.

2. Methods

Altogether, 20 participants (7 female, 13 male) aged 18–24 years (M_{age} = 21.30 years, SD = 1.38 years) took part in the study. Data from four additional participants were excluded because they did not achieve the performance minimum of 75% accuracy across all trials (cf. Sloutsky, Kloos, & Fisher, 2007). All participants reported normal vision without the need for corrective lenses. Written informed consent was obtained from each participant. The study was carried out in accordance with the Helsinki Declaration of 1975.

Participants sat at a distance of about 45 cm from a 15″ PC monitor, so that the visual angle of the display was about 34° horizontal × 27° vertical. Primes – successfully used in pilot studies (e.g., Hüttermann, Memmert, & Bock, 2012) – were adopted from a set of 20 adjectives describing a narrow attentional focus and 20 adjectives describing a broad focus of attention (word set 1: *close, strict, accurate, special, sole, subtle, compressed, thorough, intense, enclosed, linear, direct, small, exact, detailed, slim, precise, specific, short, limited;* word set 2: *far, approximate, global, universal, multiple, broad, open, general, common, spacious, distant, long, big, blanket, comprehensive, allround, distributed, large, rough, total*). The prime words were presented on the screen in lowercase letters (average height 0.8 cm), in black on a white background. Primes were extended to a length of 13 letters by adding "+" characters to the left and to the right so that all primes had the same length. Two non-word letter strings (either "npxqh" or "npxlh", cf. Kiesel, Kunde, Pohl, & Hoffmann, 2006) were additionally used as neutral primes. Each prime was displayed for 32 ms, and was followed by a mask of 13 "#" characters for 50 ms.

Targets were illustrations of traffic scenarios similar to those used in drivers' license tests. Sixteen different scenarios were created with the software E-Prime®, each depicting an intersection with "yield" and/or priority signs and with two or three vehicles (cars, trucks, and/or motorcycles in light or dark gray). The scenarios were displayed across the whole screen ("global targets", see Fig. 1, top panel), or only within the central quarter of the screen area ("local targets" see Fig. 1, bottom panel).

The order of events on each trial is illustrated in Fig. 1. A black fixation cross appeared for 500 ms, followed by prime and mask, which were again followed by the target. Participants were instructed to first fixate the cross and then to use the computer mouse to touch the displayed vehicles one after the other, in the order in which they were allowed to pass through the intersection according to the traffic rules; they were asked to complete the task as quickly as possible. (An experimenter ensured that participants actually clicked on the vehicles and did not click two or three times in row in order to be faster). The next trial started immediately after the last (2nd or 3rd) vehicle was touched. Each subject completed four practice trials followed by 60 experimental trials with six combinations of prime type (local prime – local target, global prime – local target, neutral prime – local target, local prime – global target, global prime – global target, and neutral prime – global target) each randomly varying ten times. Target difficulty (2 or 3 vehicles) as well as the prime word from the set of semantically similar words were also selected randomly.

Response times from target onset to the first vehicle touch were averaged within the prime types congruent (prime and target both global or both local), incongruent (one of prime or target global, the other local), and neutral (prime neutral) in respective of target size. The outcome was submitted to a 3 × 2 × 2 ANOVA with repeated measures on the factors Prime type (congruent, incongruent, neutral), target Size (global, local), and task Complexity (two vehicles, three vehicles). When the assumption of sphericity was violated, p-values were adjusted by the conservative Greenhouse–Geisser method.

2.1. Prime visibility test

Subsequent to the main experiment, we conducted a prime visibility test[1] with 13 new participants (8 female, 5 male) aged 19–26 years (M_{age} = 21.85 years, SD = 1.77 years). They were submitted to the same procedures as in the main experiment, but in addition, they were informed about the presence of prime words. As in the main experiment, participants had to indicate the order in which vehicles were allowed to pass through the intersection. Afterwards, they were asked whether the masked prime words described a narrow or a broad attentional focus, or a non-word letter string. They were encouraged to make the best guess if they were unsure about the correct answer.

[1] The prime visibility test was conducted after the main experiment because we collected these data in response to a reviewer's suggestion.