Research Article

Partial Awareness Creates the "Illusion" of Subliminal Semantic Priming

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ABSTRACT—*We argue that the lack of consensus regarding the existence of subliminal semantic processing arises from not taking into account the fact that linguistic stimuli are represented across several processing levels (features, letters, word form) that can independently reach or not reach awareness. Using masked words, we constructed conditions in which participants were aware of some letters or fragments of a word, while remaining unaware of the whole word. Three experiments using the Stroop priming paradigm show that when the stimulus set is reduced and participants are encouraged to guess the identity of the prime, such partially perceived stimuli can nonetheless give rise to "semantic" processing. We provide evidence that this effect is due to illusory reconstruction of the incompletely perceived stimulus, followed by usual semantic processing of the result. We conclude that previously reported unconscious Stroop priming is in fact a conscious effect, but applied to a perceptual illusion.*

To what extent can subliminal stimuli be processed semantically? Although this question has been studied for more than a century, little agreement has emerged from the literature (e.g., Dixon, 1971; Eriksen, 1960; Holender, 1986; Sidis, 1898). It is largely accepted that low-level computations (e.g., motor reflexes, sensory processing) can occur unconsciously, but the existence of high-level computations (e.g., semantic, inferential processing) without awareness remains highly controversial (see Dehaene, 2002).

A priori, whether unconscious perception reflects "smart" or "dumb" processes (Greenwald, 1992) should be easily resolved: Present a stimulus that is masked so that participants are unaware of it, and demonstrate, by means of an indirect measure (such as decision time on a subsequently presented conscious target), that semantic aspects of the masked stimulus have nonetheless been activated. However, such an empirical test turns out to be extremely difficult to construct. Indeed, leaving aside the problem of finding proper masking methods and measures of semantic activation that are sensitive enough, the main difficulty has been devising an adequate test of conscious awareness. Researchers have disagreed on whether they should use objective perceptibility tests, which require participants to identify or perform a forced-choice decision on the masked stimuli (Holender, 1986), or subjective reports, in which participants directly indicate their state of phenomenal awareness of the masked stimuli (Merikle & Cheesman, 1986). In the absence of consensus, it seems wise to use both sources of information simultaneously to decide the issue, and this is our approach in this article.

Another problem might explain the lack of empirical consensus obtained so far. All previous tests that have been proposed presuppose that awareness is an all-or-none notion. Although this assumption may be valid in the case of simple stimuli such as pure tones or simple visual features, it is far from adequate in the case of complex, hierarchically organized stimuli such as pictures or words. Such stimuli are represented at several levels of detail (in the case of words: features, letters or phonemes, whole word). Hence, it is logically possible that particular masking conditions will affect certain levels but not others. For instance, on a given trial, one could be able to identify certain letters or fragments, while being unable to identify the whole word. We call this hypothetical state "partial awareness," as opposed to "global awareness," in which the stimulus is identified at all processing levels.

The potential existence of partial awareness has been overlooked by researchers who have tested unconscious semantic processing. This is unfortunate because under partial-awareness conditions, participants may use the letters or features that they have perceived to guess what the stimulus was (on the basis of contextual information provided by the target, the task, expectancies, and so forth; see Bernstein, Bissonnette, Vyas, & Barclay, 1989; Briand, den Heyer, & Dannenbring, 1988; Dark, 1988). Once the stimulus has been reconstructed, it can be semantically processed, giving rise to the appearance of unconscious semantic activation.

To test for the existence of partial awareness, we built on the well-documented "unconscious" Stroop priming effect (Marcel, 1983;

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Merikle, Smilek, & Eastwood, 2001). The Stroop priming paradigm typically consists of the presentation of a color word prime (e.g., RED) followed by a target color about which participants perform a color decision (e.g., "is the string &&&& colored in green or red?"). Merikle and his colleagues showed that if primes are masked and presented briefly (i.e., 33 ms), there is a significant facilitation when the color of the string of ampersands is congruent with the color prime, compared with when the color of the string is incongruent with the color prime (Cheesman & Merikle, 1986; Merikle & Joordens, 1997; Merikle, Joordens, & Stolz, 1995). Although some studies failed to replicate this effect when identification of the word was at chance level (Cheesman & Merikle, 1984; Tzelgov, Porat, & Henik, 1997), Stroop priming has been considered genuinely unconscious on the grounds that participants considered themselves to be unable to perform various prime discrimination tasks (e.g., discriminate between real and pseudo color words such as YELLOW and YOLLEW; see Cheesman & Merikle, 1986).

However, one should consider this argument with caution, in light of the distinction between global and partial awareness. Indeed, although awareness was tested at the level of words, it was not tested at the level of letters. In Stroop priming, given that participants are dealing with a very small set of color words repeated several times and are encouraged to guess the identity of the prime,[1] fragments or letters (e.g., Y_LL_W) may be all that is needed to reconstruct the underlying word and give rise to a Stroop priming effect. Because fragments would be very similar for real and pseudo color words, participants would not be able to discriminate between these two types of items. Hence, one would obtain a Stroop priming effect while participants were unaware of the prime stimuli at the global level, but still aware at the partial level. Note that this hypothesis makes the critical prediction that Stroop priming should be found for pseudo color words, as well as for real color words. Indeed, if participants reconstruct the prime stimuli using letters, they should do this for pseudo as well as for real color words. Thus, the more participants rely on partial awareness, the less difference there should be between the influence of pseudo and real color words. This is exactly the prediction we tested in our experiments.

Experiment 1 was designed to replicate Merikle's Stroop priming effects with masked color words in French (e.g., BLEU), while showing that pseudo color words (e.g., BELU) can yield similar effects. The masking procedure was very similar to the one used by Merikle and Joordens (1997, Experiment 1), with the exception that two prime durations (29 ms and 43 ms) were used instead of a single one (33 ms), as in their study. We assumed that at the 29-ms prime duration, which is close to the 33-ms duration used by Merikle and Joordens, participants should be able to access only some letters (partial awareness). Hence, equal priming should be obtained for real and pseudo color words with this prime duration. In contrast, with 43-ms primes, participants should start to distinguish real from pseudo color words, and therefore priming for pseudo words should drop to zero. Experiment 2 used a more powerful masking procedure and compared partial awareness and truly subliminal conditions. Experiment 3 tested for the importance of explicitly asking the participants to guess the prime.

[1]Although it was explicitly mentioned in the earlier publication (Cheesman & Merikle, 1986) but not the recent ones (Merikle & Joordens, 1997; Merikle et al., 1995), participants in these studies were indeed instructed not to simply perform the color decision task, but also to try to identify the masked primes as much as they could before responding to the target (S. Joordens, personal communication, April 1, 2001).

EXPERIMENT 1

Method

Participants

Twelve students recruited in Paris served as participants. They reported normal or corrected-to-normal vision and were native speakers of French.

Materials, Design, and Procedure

On each trial, the target was a string of seven ampersands (i.e., &&&&&&&) colored red or green. The prime was one of the four real color words "ROUGE," "VERT," "JAUNE," and "BLEU" (in English: "red," "green," "yellow," and "blue," respectively); one of the four pseudo color words "RUGOE," "VRET," "JANUE," and "BELU"; or the neutral prime "XXXXX."

The main experiment consisted of 280 trials corresponding to 7 repetitions of the 32 combinations of prime letter strings and color targets (4 primes × 2 lexicalities × 2 prime durations × 2 targets) and 14 repetitions of the 4 combinations of targets with the neutral prime (1 prime × 2 prime durations × 2 targets). Thus, 20% of the trials were neutral (i.e., used the neutral prime), 20% were congruent, and 60% were incongruent (excluding neutral primes, 25% were congruent and 75% were incongruent). In addition, there were 20 practice trials.

The sequence of events for each trial (see Fig. 1) was as follows: (a) a gray fixation cross for 500 ms, (b) a blank screen for 200 ms, (c) a gray prime for 29 ms or 43 ms, (d) a backward mask consisting of seven gray ampersands for 258 ms, and (e) the target consisting of seven red or green ampersands. The target remained on the screen until either a response was made or 2 s had elapsed. The next trial started 500 ms after participants gave a response. All events were presented in a fixed-width font (Helvetica) against a black background and displayed on a 133-MHz Pentium computer connected to a CRT screen (70-Hz refresh rate). The experiment was run using the EXPE software package (Pallier, Dupoux, & Jeannin, 1997).

Participants' principal task was to decide as quickly and as accurately as possible whether the last string of ampersands appeared in red or in green. They had to respond with the left hand for "green" and with the right hand for "red." They were informed of the presence of the four real color word primes but not of the pseudo color words or neutral primes. As in the experiments by Merikle and his colleagues (see footnote 1), participants also had the secondary task of trying to read the prime while preparing their response to the target.

Results and Discussion

Trials with errors (2.98%) or response times above 1,200 ms (0.48%) were excluded. The data were analyzed using a within-participants analysis of variance (ANOVA) with factors of prime lexicality (real or pseudo words), prime duration (29 ms or 43 ms), and Stroop priming (congruent vs. incongruent trials). Results of this analysis are plotted in Figure 2. There was a main effect of Stroop priming, $F(1, 11) = 18.69, p < .001$, which interacted with prime lexicality, $F(1, 11) = 4.61, p < .10$. Planned comparisons indicated significant Stroop priming for

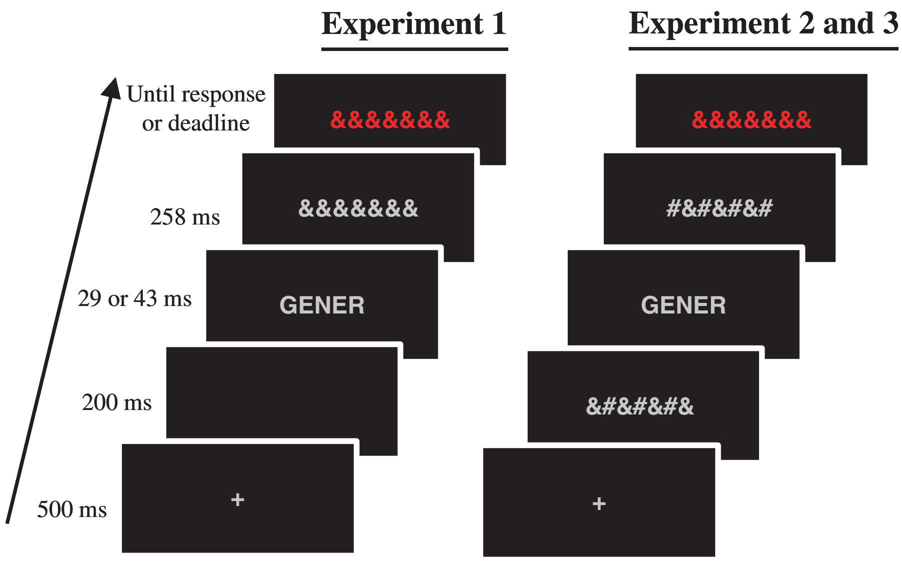


Fig. 1. Sequence of events used in Experiment 1 (left) and in Experiments 2 and 3 (right). The primes in these examples are English (GENER, based on GREEN), but in the experiments, the primes were pseudo and real French color words (e.g., VRET, based on VERT).

real words (43 ms), $F(1, 11) = 20.88$, $p < .001$, and, critically, also for pseudo color words (23 ms), $F(1, 11) = 7.10$, $p < .05$.

Separate ANOVAs for the two prime durations showed contrasting patterns. For 43-ms primes, Stroop priming was found for real color words (60 ms), $F(1, 11) = 17.08$, $p < .005$, but not for pseudo color words (10 ms), $F < 1$. Thus, Stroop priming with 43-ms primes was restricted to real words, as indicated by a significant interaction with prime lexicality, $F(1, 11) = 8.25$, $p < .001$. In contrast, for 29-ms

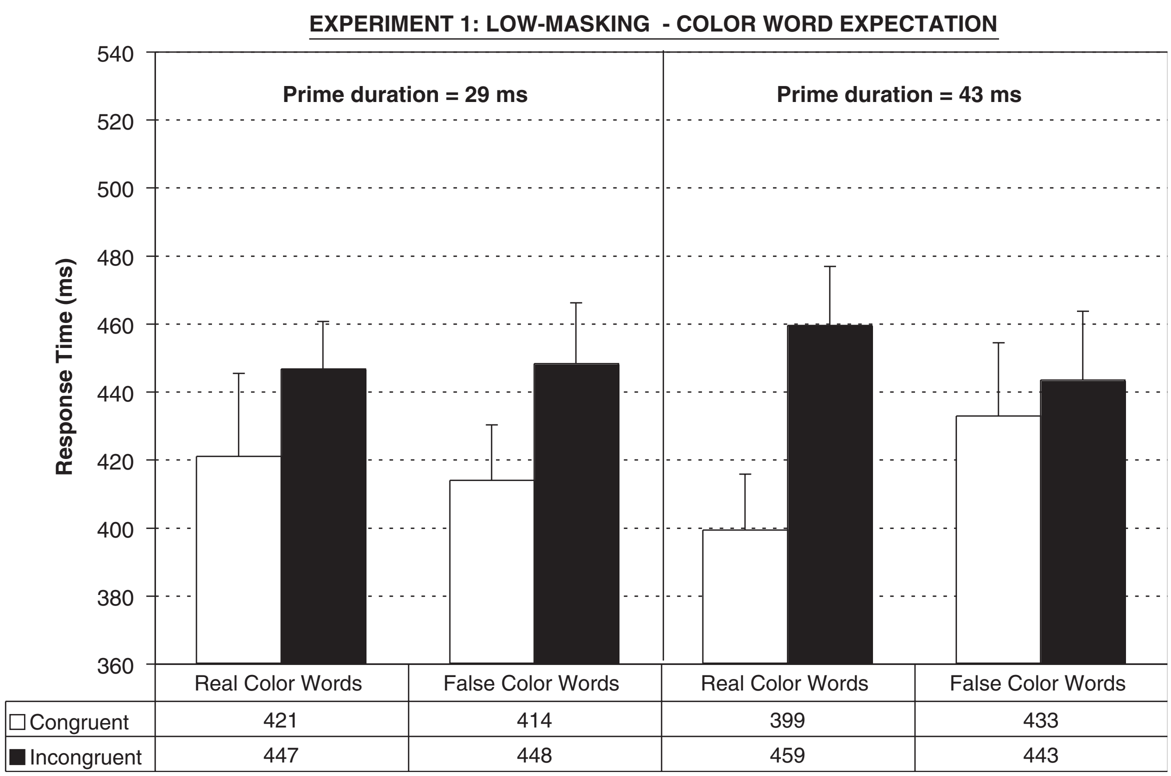


Fig. 2. Stroop priming effects in Experiment 1 as a function of prime duration (29 or 43 ms) and prime lexicality (real or pseudo color words). Error bars correspond to 1 *SE*.

primes, Stroop priming was significant (30 ms), $F(1, 11) = 6.52, p < .05$, but there was no interaction with prime lexicality, $F < 1$. The amplitude of the effect was about the same for real color words (26 ms), $F(1, 11) = 3.20, p = .10$, and pseudo color words (34 ms), $F(1, 11) = 4.04, p = .07$. In order to know whether the global Stroop priming effect resulted from facilitation due to congruent trials or from inhibition due to incongruent trials, we performed comparisons against the neutral-primes condition. These comparisons revealed both a facilitation of 21 ms, $F(1, 11) = 6.53, p < .05$, and an inhibition of 12 ms, $F(1, 11) = 16.20, p < .005$.

In summary, Experiment 1 replicates studies performed with real color words (Merikle & Joordens, 1997; Merikle et al., 1995). However, our experiment shows that pseudo color words also contribute to this effect. Moreover, the results are concordant with the hypothesis that partial awareness is critical: The harder it was to see the primes, the less difference there was between the influence of real and pseudo color words. Indeed, the more difficult primes are to perceive, as with the 29-ms duration, the more participants rely on their expectations and the partial information available regarding the identity of the primes. Thus, in these conditions, pseudo color words are processed as if they were real color words. When primes are easier to perceive, as with 43-ms primes, global awareness becomes possible, and pseudo color words do not show any priming effects because they are no longer confounded with real words. Participants' verbal reports are consistent with this interpretation, in that all participants reported having noticed the presence of pseudo color words when interviewed after the experiment.

EXPERIMENTS 2 AND 3

The goal of Experiment 2 was to contrast a situation in which subjects can be only partially aware of the prime stimuli with a situation in which the stimuli are truly subliminal. We used the same procedure as in Experiment 1, except that the strength of the mask was increased (and a forward mask was added), while the prime durations were kept the same. Informal pilot testing suggested that in these conditions it is possible to see some letters of the 43-ms primes but not of the 29-ms primes. According to our hypothesis, under these conditions Stroop priming should be found for the 43-ms primes and be equal for real and pseudo color words, whereas priming should drop to zero for 29-ms primes. Furthermore, to test the hypothesis that partial awareness is a function of participants' guessing strategies, we used exactly the same procedure in Experiment 3, but we did not inform the participants about the existence of the primes. Finally, in order to buttress our interpretation that partial awareness is a necessary condition for Stroop priming, we ran two prime-visibility tests after Experiment 3. These tests consisted of a lexical decision (global-awareness test) and a letter decision (partial-awareness test) about the prime stimuli.

Method

Participants

Two groups of 12 students served as participants in the two experiments. All participants reported normal or corrected-to-normal vision and were native French speakers. None of the participants had taken part in the previous experiment.

Materials, Design, and Procedure

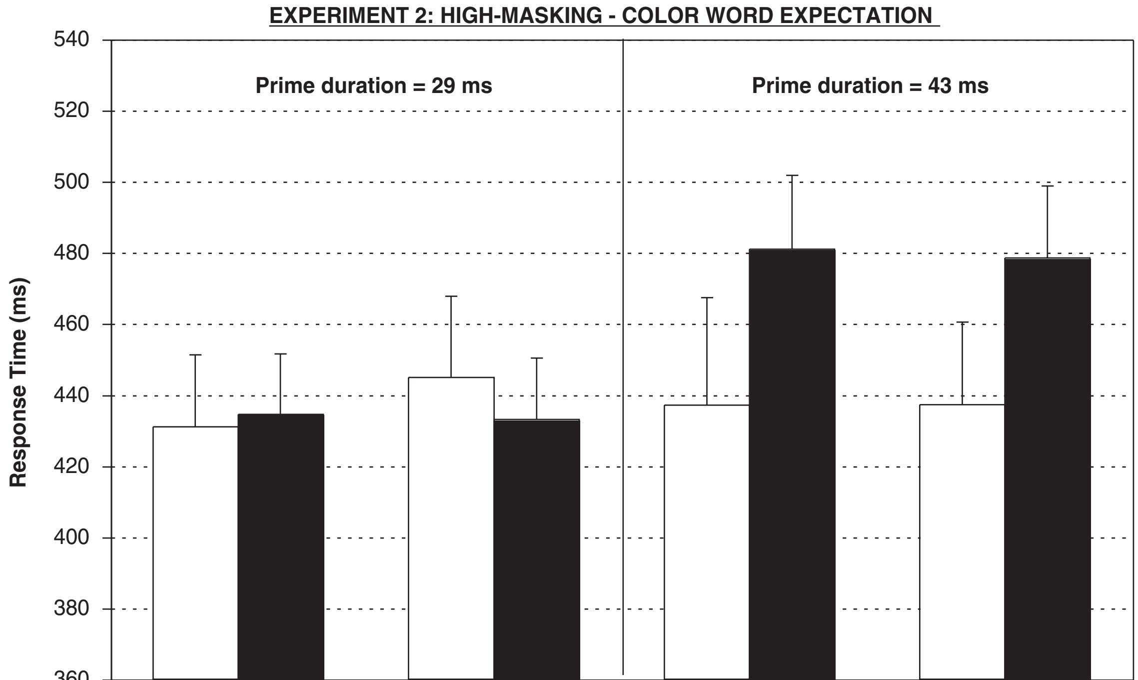
The materials and design were the same as in Experiment 1, except for the following changes: First, in Experiments 2 and 3, the 200-ms blank screen preceding the prime was replaced with a forward mask consisting of three pound signs and four ampersands (i.e., &#&#&#&), and the backward mask was changed to four pound signs and three ampersands (i.e., #&#&#&#; see Fig. 1). Second, in Experiment 3, participants were not informed about the presence of prime words and were instructed only to decide as quickly and as accurately as possible whether the final target appeared in red or in green. Third, after Experiment 3, participants were told that real and pseudo color words had been presented during the experiment. They were given two perceptibility tasks: a lexical decision task and a letter decision task (Kouider & Dupoux, 2001), corresponding, respectively, to global- and partial-awareness tests. The lexical decision task required discriminating between the four real color words and the four pseudo color words. The letter decision task involved discriminating between strings of real letters (pseudo and real color words) and strings of pseudo letters. Pseudo letters were created by rotating real Helvetica letters (see Kouider & Dupoux, 2001, for details). Each perceptibility test included 64 trials, and the order of the two tests was counterbalanced across participants. The lexical decision task consisted of 2 repetitions of the 32 combinations of prime letter strings and targets (4 primes $\times$ 2 lexicalities $\times$ 2 prime durations $\times$ 2 targets). The letter decision task consisted of one occurrence of these 32 combinations plus 32 trials in which different random pseudo letter strings preceded 1 of the targets (the 2 targets appeared equally often).

Results and Discussion

Stroop Priming

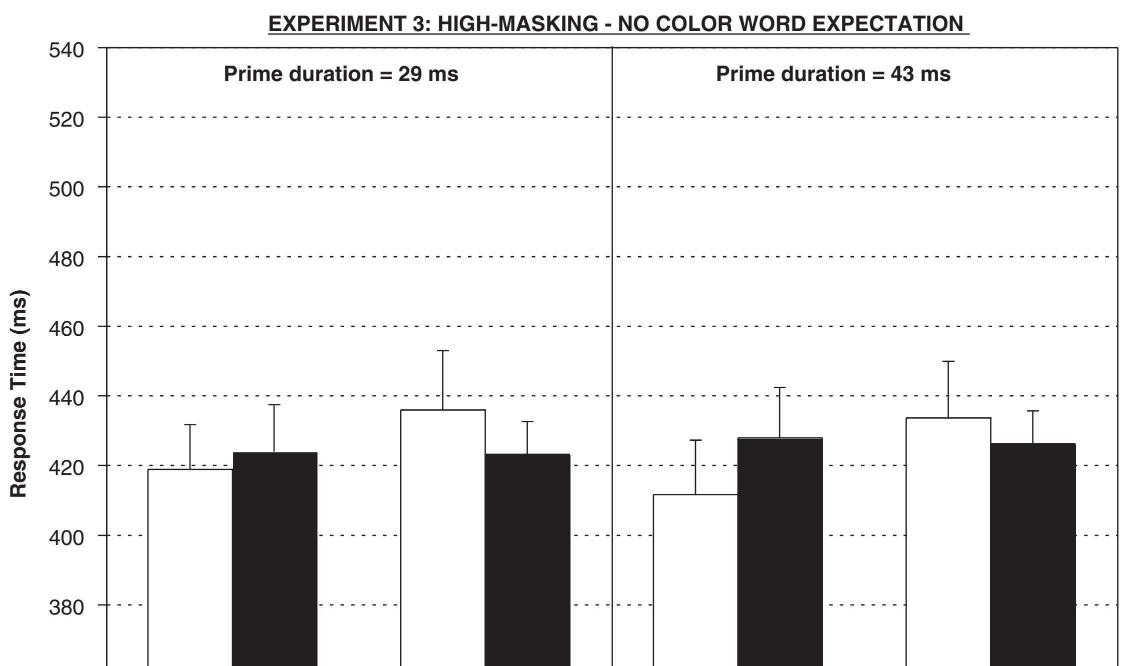
Response latencies in Experiment 2 are presented in Figure 3. Experiment 2 showed a main effect of Stroop priming (19 ms), $F(1, 11) = 6.28, p < .05$, which interacted with prime duration, $F(1, 11) = 11.97, p < .005$. Crucially, no interaction was found with prime lexicality (all Fs > 1). For the 43-ms primes, planned comparisons revealed a 42-ms Stroop priming effect, $F(1, 11) = 16.87, p < .005$. This effect was independent of prime lexicality, $F < 1$, and was significant for real words (44 ms), $F(1, 11) = 10.64, p < .005$, as well as for pseudo color words (41 ms), $F(1, 11) = 8.62, p < .02$. With 29-ms primes, there was no global Stroop priming, nor was there an effect when restricting the analysis to real or pseudo words (all Fs < 1.5). When interviewed after the experiment, all participants reported that whenever they saw a prime, it was a real color word. When explicitly told that pseudo color words had been presented, no participant reported having noticed any of them.

Response latencies in Experiment 3 are presented in Figure 4. In Experiment 3, most participants did not notice the presence of prime stimuli. Only 3 participants out of 12 reported having seen primes, and all the primes they reported seeing were real color words. The 9 remaining participants reported that they did not notice any word or letters during the experiment. In contrast to the previous experiments, Experiment 3 revealed a clear absence of a global Stroop priming effect: The difference between response times in the congruent and incongruent trials was 0 ms. Planned comparisons revealed no effect in any condition (all Fs < 2), except for a marginal effect of 17 ms for 43-ms real word primes, $F(1, 11) = 3.294, p = .10$. Comparisons



	Real Color Words	False Color Words	Real Color Words	False Color Words
□ Congruent	431	445	437	437
■ Incongruent	435	433	481	478

Fig. 3. Stroop priming effects in Experiment 2 as a function of prime duration (29 or 43 ms) and prime lexicality (real or pseudo color words). Error bars correspond to 1 *SE*.



	Real Color Words	False Color Words	Real Color Words	False Color Words
□ Congruent	419	436	411	433
■ Incongruent	424	423	428	426

Fig. 4. Stroop priming effects in Experiment 3 as a function of prime duration (29 or 43 ms) and prime lexicality (real or pseudo color words). Error bars correspond to 1 *SE*.

between aware and unaware participants showed that this marginal effect increased to 38 ms for the 3 aware participants, but was not significant for the 9 unaware participants ($F < 1$).

Prime Perceptibility

A measure of prime perceptibility in the form of a d' value was computed for each participant of Experiment 3, for each prime-perceptibility task and for each prime duration (see Table 1). It was obtained by treating the presence of real letters as signal and the presence of pseudo letters as noise in the letter decision task, and real color words as signal and pseudo color words as noise in the lexical decision task. We also ran an ANOVA against the null mean in order to check whether the observed d' was significantly different from 0. This analysis revealed a global average d' of 0.43, which was significant, $F(1, 11) = 6.135, p < .05$, and interacted with the task, $F(1, 11) = 11.876$, $p < .005$, as well as with prime duration, $F(1, 11) = 5.526$, $p < .05$. There was also a triple interaction, $F(1, 11) = 8.998$, $p < .02$, corresponding to the fact that with 29-ms primes, participants' performance was not significantly above chance in either task (letter decision: $d' = 0.27$; lexical decision: $d' = 0.02$; all Fs < 1), whereas with 43-ms primes, performance was at chance in the lexical decision task ($d' = -0.02$; all Fs < 1), but not in the letter decision task ($d' = 1.44$), $F(1, 11) = 18.679, p < .001$. Thus, given the masking conditions used in Experiments 2 and 3, only partial awareness was possible with 43-ms primes, whereas no awareness at all was possible with 29-ms primes.

GENERAL DISCUSSION

The goal of this article was to establish the existence of a state that we call partial awareness—a situation in which participants can identify some of the letters in a letter string (they are able to discriminate between real letters and featurally matched pseudo letters), but are very poor at identifying the entire letter string (they cannot perform a lexical decision on the letter string). We predicted that when participants processed the primes under partial-awareness conditions, equal priming would be found for real and pseudo color words. This prediction was verified in two experiments: in Experiment 1, with a low-masking procedure and a stimulus duration of 29 ms, and in Experiment 2, with higher-masking conditions and a stimulus duration of 43 ms. In both cases, we found evidence for semantic processing of the masked stimuli, because we obtained a Stroop priming effect. However, this effect was as strong for real color words (e.g., GREEN) as for pseudo color words (e.g., GENER), suggesting that it was due to the identification of some letters, but not to the identification of the entire letter string as a word. This latter point was substantiated by showing that for the 43-ms primes with high masking (Experiment 2), participants performed at chance levels in a lexical decision task on the primes (global-awareness measure), but above chance in a letter decision on the primes (partial-awareness measure). Note that pseudo color words do not always produce Stroop priming. Indeed, in Experiment 1, the 43-ms primes tended to be globally visible, and Stroop priming disappeared for pseudo color words. In brief, under partial awareness, participants are able to perceive a few letters and use them to reconstruct the color word, resulting in a "conscious" masked Stroop priming effect.

TABLE 1
Prime Perceptibility* (d′) *as a Function of Task and Prime Duration

	Task	
Prime duration	Letter decision	Lexical decision
29 ms	0.27	0.02
43 ms	1.44*	–0.02

*$p < .01$.

On the phenomenological side, participants experienced only the result of this perceptual reconstruction process. Indeed, in Experiment 2, they reported having seen only true color names and were very surprised to learn that nonwords had been presented to them. The reconstructed primes can be considered as perceptual illusions that arise from the conjunction of bottom-up information (the identified letters) and top-down expectations (the reduced set of color words and guessing strategy). When top-down expectations are removed (Experiment 3), the illusions disappear, and so does Stroop priming. We now discuss the implications of our findings regarding perceptual awareness tests and the existence of unconscious semantic processing.

Methodologically speaking, these results suggest that in order to assess the amount of unconscious processing that takes place, awareness tests at a single level are not sufficient. Instead, several levels of awareness need to be tested. When dealing with a complex stimulus, such as a word or picture, it is important to verify the perceptual availability not only of the stimulus's identity at the highest level of representation, but also of some of the stimulus's subcomponents, because these subcomponents can have a critical influence on the indirect measure (e.g., priming). Such a requirement depends on the experimental situation and is crucially important in experiments that use a limited set of stimuli that are repeated several times. Thus, before concluding that subliminal processing has occurred, one should check for awareness of each kind of subcomponent. The methodology we introduced included foils, that is, items that share many of the features of the prime item, but not its identity. Foils permit one to test for the level of detail at which participants have access to the prime, and for which aspects of the stimulus are crucial for an effect to emerge.

These implications should be extended to paradigms that use only tests of global awareness. For instance, consider the primed exclusion task (Debner & Jacoby, 1994; Merikle & Joordens, 1997; Merikle et al., 1995), in which participants have to complete a target stem such as "di____" with any word that comes to mind, except the prime (e.g., "diner"). Debner and Jacoby have shown that exclusions are possible when primes are presented for a relatively long duration (150 ms), but cannot be performed any more when primes are masked and presented for a brief duration (50 ms). Instead, in this latter condition, participants are more likely to complete a stem with the prime word itself. This failure to exclude masked primes while being influenced by them has been used as an argument for a process dissociation between conscious and unconscious perception (Debner & Jacoby, 1994; Merikle et al., 2001). However, it is possible that the "unconscious" condition is in fact a partial-awareness condition in which participants perceive a few letters of the prime, but not the entire prime. These consciously perceived letters may then be used to complete the stem, giving rise to an apparent unconscious priming effect (see Block, 2001, for a similar proposal). In order to test this possibility, it would be useful to compare the usual primes (e.g., "diner") with an orthographic baseline (e.g., "tuner"). If this effect results from conscious perceptibility of the letters used for completion ("-ner"), there should be equal priming for the two conditions. Another way of testing this hypothesis would be to ask participants to complete the target while excluding all letters of the prime.

Let us now turn to the implications of our results regarding the notion of semantic processing without awareness. Our results cast doubts on the interpretation of previous studies using masked Stroop priming (e.g., Merikle & Joordens, 1997). Indeed, we have found that when the masking is sufficient to disrupt performance of a letter decision task, Stroop priming does not occur (Experiment 2, 29-ms primes). Furthermore, when letter decision is possible but participants are not trying to guess what the prime is, no Stroop priming is found (Experiment 3, 43-ms primes). This observation strongly suggests that previous reports of masked Stroop priming are best explained by the partial-awareness hypothesis, according to which this effect arises when participants are consciously aware of some letters and seek to exploit them to reconstruct the stimuli.

At a more general level, our results are consistent with those we reported for a previous study (Kouider & Dupoux, 2001) in which, contrary to within-modal repetition priming, cross-modal repetition priming was found only under partial awareness but not under truly subliminal conditions. Our conclusions are also consistent with recent results reported by Abrams and Greenwald (2000) suggesting that previous evidence for unconscious emotional effects (affective priming) can be reinterpreted as response strategies based on letters or word fragments. In brief, reinterpreting the claim by Holender (1986) that there is no semantic activation without conscious identification, we raise the conjecture that the only situations in which semantic priming is found are cases of global awareness or of partial awareness. Truly unconscious priming is restricted to formal (or morphological) identity priming, within the same input modality (see Kouider & Dupoux, 2001; Rastle, Davis, Marslen-Wilson, & Tyler, 2000; see Forster, Mohan, & Hector, in press, for a review). Further research is needed to thoroughly test this conjecture.

REFERENCES

Abrams, R.L., & Greenwald, A.G. (2000). Parts outweigh the whole (word) in unconscious analysis of meaning. *Psychological Science*, *11*, 118–124.

Bernstein, I.H., Bissonnette, V., Vyas, A., & Barclay, P. (1989). Semantic priming: Subliminal perception or context? *Perception & Psychophysics*, *45*, 153–161.

Block, N. (2001). Paradox and cross purposes in recent work on consciousness. *Cognition*, *79*, 197–219.

Briand, K., den Heyer, K., & Dannenbring, G.L. (1988). Retroactive semantic priming in a lexical decision task. *Quarterly Journal of Experimental Psychology*, *40A*, 341–359.

Cheesman, J., & Merikle, P.M. (1984). Priming with and without awareness. *Perception & Psychophysics*, *36*, 387–395.

Cheesman, J., & Merikle, P.M. (1986). Distinguishing conscious from unconscious perceptual processes. *Canadian Journal of Psychology*, *40*, 343–367.

Dark, V.J. (1988). Semantic priming, prime reportability, and retroactive priming are interdependent. *Memory & Cognition*, *16*, 299–308.

Debner, J.A., & Jacoby, L.L. (1994). Unconscious perception: Attention, awareness, and control. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *20*, 304–317.

Dehaene, S. (2002). *The cognitive neuroscience of consciousness*. Cambridge, MA: MIT Press.

Dixon, N.F. (1971). *Subliminal perception: The nature of a controversy*. London: McGraw-Hill.

Eriksen, C.W. (1960). Discrimination and learning without awareness: A methodological survey and evaluation. *Psychological Review*, *67*, 279–300.

Forster, K.I., Mohan, K., & Hector, J. (in press). The mechanics of masked priming. In S. Kinoshita & S.J. Lupker (Eds.), *Masked priming: State of the art*. Hove, England: Psychology Press.

Greenwald, A.G. (1992). New look 3: Reclaiming unconscious cognition. *American Psychologist*, *47*, 766–779.

Holender, D. (1986). Semantic activation without conscious identification in dichotic listening, parafoveal vision, and visual masking: A survey and appraisal. *Behavioral and Brain Sciences*, *9*, 1–23.

Kouider, S., & Dupoux, E. (2001). A functional disconnection between spoken and visual word recognition: Evidence from unconscious priming. *Cognition*, *82*, 35–49.

Marcel, A.J. (1983). Conscious and unconscious perception: Experiments on visual masking and word recognition. *Cognitive Psychology*, *15*, 197–237.

Merikle, P.M., & Cheesman, J. (1986). Consciousness is a "subjective" state. *Behavioral and Brain Sciences*, *9*, 42–43.

Merikle, P.M., & Joordens, S. (1997). Parallels between perception without attention and perception without awareness. *Consciousness and Cognition*, *6*, 219–236.

Merikle, P.M., Joordens, S., & Stolz, J. (1995). Measuring the relative magnitude of unconscious influences. *Consciousness and Cognition*, *4*, 422–439.

Merikle, P.M., Smilek, D., & Eastwood, J.D. (2001). Perception without awareness: Perspectives from cognitive psychology. *Cognition*, *79*, 115–134.

Pallier, C., Dupoux, E., & Jeannin, X. (1997). EXPE: An expandable programming language for on-line psychological experiments. *Behavior Research Methods, Instruments, & Computers*, *29*, 322–327.

Rastle, K., Davis, M.H., Marslen-Wilson, W.D., & Tyler, L.K. (2000). Morphological and semantic effects in visual word recognition: A time-course study. *Language and Cognitive Processes*, *15*, 507–537.

Sidis, B. (1898). *The psychology of suggestion*. New York: D. Appleton and Co.

Tzelgov, J., Porat, Z., & Henik, A. (1997). Automaticity and consciousness: Is perceiving the word necessary for reading it? *American Journal of Psychology*, *110*, 429–448.

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