Research Article

PARTS OUTWEIGH THE WHOLE (WORD) IN UNCONSCIOUS ANALYSIS OF MEANING

Richard L. Abrams and Anthony G. Greenwald

University of Washington

Abstract—*In unconscious semantic priming, an unidentifiable visually masked word (the prime) facilitates semantic classification of a following visible related word (the target). Three experiments reported here provide evidence that masked primes are analyzed mainly at the level of word parts, not whole-word meaning. In Experiment 1, masked nonword primes composed of subword fragments of earlier-viewed targets functioned as effective evaluative primes. (For example, after repeated classification of the targets* angel *and* warm, *the nonword* anrm *acted as an evaluatively positive masked prime.) Experiment 2 showed that this part-word processing was potent enough to oppose analysis at the whole-word level. Thus,* smile *functioned as an evaluatively negative (!) masked prime after repeated classification of* smut *and* bile. *Experiment 3 found no priming when masked word primes contained no parts of earlier targets. These results suggest that robust unconscious priming (a) is driven by analysis of part-word information and (b) requires previous classification of visible targets that contain the fragments later serving as primes. Contrary to a widely held view, analysis of subliminal primes appears not to function at the level of analysis of complete words.*

Empirical findings of unconscious cognition typically have generated controversy in proportion to the size of their claims. Findings indicating unconscious processing at relatively low levels of analysis (as of physical features of auditory stimuli) have been widely replicated and are well established in the literature (cf. Johnson & Dark, 1986). In contrast, findings implying more complex analysis, for example, of phrase-level or sentence-level meaning, have for the most part not fared well in late-20th-century academic psychology (for a review, see Greenwald, 1992).

Between these extremes, a large body of research has focused on analysis of the whole-word meaning of single words. Some of the most compelling findings from this research come from studies of semantic priming with visually masked primes (the focus of the present research). Although still the object of critical debate, conclusions from these studies have found growing acceptance over the nearly two decades since Marcel's (1983) groundbreaking work. Acceptance has partly resulted from an increasing sophistication in methodology, which has benefited from an active theoretical debate over key measurement issues (e.g., Holender, 1986). This debate has sharpened strategies for dissociating unconscious from conscious cognition (Cheesman & Merikle, 1984, 1986; Greenwald, Klinger, & Schuh, 1995; Merikle & Cheesman, 1986). Advances in methodology and measurement strategy have produced a number of recent strong findings (e.g., Draine & Greenwald, 1998; Greenwald, Draine, & Abrams, 1996; Hirshman & Durante, 1992). Other recent research has drawn on event-related potential and imaging techniques (Dehaene et al., 1998). Collectively, this substantial evidence has been widely interpreted as showing that analysis at the whole-word level occurs for individual words made unidentifiable by visual masking.

In the experiments we report here, we revisited the question of whether whole-word analysis occurs for individual subliminal primes. In particular, we tested the possibility that unconscious semantic priming requires only, and is based largely on, analysis at the subword level.

Successful studies of unconscious semantic priming have often used a procedure in which repeatedly classified visible targets reappear on later trials as masked primes (Draine, 1997; Draine & Greenwald, 1998; Greenwald et al., 1996). Because both primes and targets reappear numerous times over the course of the experiment, analysis of any given prime occurs in the context of some number of earlier exposures to that word as a target. Earlier exposure to a word is well known to facilitate processing, and there has been speculation that it may enhance unconscious priming by speeding access to masked primes (Klauer & Musch, 1998). More specifically, prior exposure may reduce the information required for a masked prime to be effectively analyzed.

Consider a typical priming task in which targets and primes belong to one of two semantic categories, such as evaluatively positive and negative. When the word *charm* appears for the first time as a masked prime, its whole-word meaning has to be analyzed for it to produce category-specific activation. (Partial analysis would not distinguish *charm* from evaluatively negative words in the language, like *cheat* and *alarm*.) But, after repeated categorization of a set of targets that include *charm* (but not *cheat* or *alarm*), partial information from a masked prime that is consistent only with *charm* might suffice to "trigger" activation associated with that whole word. This possible effect of earlier exposure is broadly supported by models that posit analysis on the basis of lowered threshold or reduced information for words that have been recently viewed (e.g., Morton, 1969; Treisman, 1960).

To test the possibility that partial analysis underlies unconscious priming, we designed an experiment in which the masked primes were not the intact words that had appeared earlier as targets, but hybrid primes composed of rearranged parts of earlier (parent) targets. This strategy allowed us to compare priming due to subword elements (two- or three-letter sequences) with priming due to whole-word content. In Experiment 1, parts from two targets of the same evaluative category (positive or negative) were recombined to form nonwords. For example, parts of the evaluatively positive parent targets *humor* and *tulip* were recombined to form the nonword *hulip* (we call these nonwords *hulip-type hybrid primes*). Effective priming by *hulip*-type hybrid primes would support the hypothesis that unconscious semantic priming requires no more than the analysis of subword elements.

EXPERIMENT 1

Subjects

Four male and 8 female University of Washington undergraduates participated in exchange for credit toward a course requirement. All

Address correspondence to Richard Abrams or Anthony Greenwald, Psychology Department, University of Washington, Box 351525, Seattle, WA 98195-1525; e-mail: rlabrams@u.washington.edu or agg@u.washington.edu.

 Copyright © 2000 American Psychological Society

had normal or corrected-to-normal vision, were fluent in English, and were naive about the hypothesis of the experiment.

Materials

Targets were a set of 24 words with unambiguously pleasant or unpleasant meaning, most chosen from a set whose affective valence had been rated in earlier testing (Bellezza, Greenwald, & Banaji, 1986). From these, a set of 24 *hulip*-type hybrid primes was formed by recombining parts (usually two to three letters) from two same-category parent targets. Examples of *hulip*-type hybrid primes are *virer* (*virtue* + *cheer*), *anrm* (*angel* + *warm*), *biut* (*bile* + *smut*), and *frath* (*fraud* + *death*). All targets and primes were four to six letters long. Targets were presented in lowercase and primes in uppercase Arial font.

Procedure and Apparatus

Priming task

Subjects first gained practice (four 48-trial blocks) categorizing clearly visible parent targets as pleasant or unpleasant in meaning. They then completed six blocks of priming trials in which both masked primes and visible targets were drawn from the set of parent words. Next, they completed the six critical blocks of priming trials in which targets continued to be drawn from the parent set, but masked primes were drawn from the set of *hulip*-type hybrids. (The *hulip*-type hybrids never appeared as visible targets in the experiment. If these primes proved effective, it would appear that part-word information was being analyzed subliminally.)

All stimuli were presented on a computer display (36-cm diagonal, 60-Hz refresh rate) in dark gray lettering against a light gray background. The sequence of events on priming trials was as follows: fixation point for 500 ms, forward mask for 150 ms, prime for 33 ms, backward mask for 33 ms, then target for 333 ms. Forward and backward masks were similar but not identical strings of eight consonants (e.g., *XZMHVKZX*). The prime and target were selected at random on each trial to yield an equal number of trials, over each block, of each of the four possible combinations of prime-target valence. Selection from the prime and target sets occurred without replacement until each set was exhausted, then selection began anew (thus, the 24-item sets were presented twice in each block in which they appeared). The target was followed by an exclamation point, the 133-ms duration of which defined the response window, an interval during which the subject was instructed to classify the target as pleasant or unpleasant in meaning. (The response window obliged subjects to respond more quickly than they ordinarily would, thereby maximizing the effect of the prime on the response to the target; see Draine & Greenwald, 1998; Greenwald et al., 1996).

Subjects responded by pressing one of two widely separated keys on a computer keyboard (one key with each hand). To signal to subjects that a response had been successfully made within the window, the exclamation point briefly turned red. At the start of the experiment, the temporal center of the 133-ms window was at 400 ms following target onset. After each block of 48 trials, the program controlling the experiment advanced or delayed the window center by 33 ms in order to sustain an error rate of approximately 35%.[1] Feedback on accuracy of responding, response latency, and response-window accuracy was provided at the end of each block.

Perceptibility task

After completing the six blocks that tested for priming by *hulip*-type hybrid primes, subjects took a test of prime perceptibility (six blocks) in which they attempted to categorize visually masked words. Because the *hulip*-type hybrid primes could not be intelligently classified as pleasant or unpleasant in meaning, the stimuli used for this task were the 24 parent target words (i.e., rather than asking subjects to classify the evaluative meaning of *anrm*, we asked subjects to classify *angel* or *warm*).

Perceptibility trials were identical to priming trials, except that subjects were instructed to disregard the exclamation point and to take as long as necessary to categorize the briefly flashed, masked word. Subjects were given two blocks of preliminary practice in this task with masked words that were made easily identifiable (in the first block by being displayed in red for 100 ms, and in the second by being displayed for 100 ms). Feedback on accuracy of responding was provided at the end of each practice or test block.

Results

Figure 1a gives the results from the priming task analyzed in terms of effective valence (EV), which was a measure of the influence of prime valence on the valence of the response to the target.[2] As Figure 1a shows, *hulip*-type hybrid primes acted as primes with the same semantic value of their parents words (e.g., *hulip*, from parents *humor* + *tulip*, acted as a pleasant-meaning prime, and *biut*, from parents *bile* + *smut*, acted as an unpleasant-meaning prime). A 2 × 2 repeated measures analysis of variance performed on the EV data, with prime type and polarity as factors, revealed a significant interaction, $F(1, 11) = 6.12$, $p < .05$, indicating greater effectiveness of whole-word parent primes (mean EV difference = .33) compared with *hulip*-type hybrid primes (mean EV difference = .26).[3] Nevertheless, it is remarkable

1. The interval between target onset and window center was increased by 33 ms if in the just-finished block (a) the error rate in classifying targets was greater than or equal to 45% or (b) the error rate was greater than or equal to 35% and mean response latency was greater than the center value of the window in that block plus 100 ms. The interval was decreased by 33 ms if error rate was less than or equal to 20% and mean latency was less than or equal to the center value of the window in that block plus 100 ms. Across all subjects for the 12 priming blocks, this produced a mean temporal center for the window of 391.3 ms following target onset. (Mean window centers in Experiments 2 and 3 were 375.6 ms and 395.4 ms, respectively.)

2. Specifically, EV was computed, separately for each category of prime within the two prime types (i.e., unpleasant and pleasant whole words and unpleasant-parts and pleasant-parts hybrids), as the proportion of trials on which unpleasant targets were incorrectly classified as pleasant minus the proportion of trials on which pleasant targets were incorrectly classified as unpleasant.

3. The EV data in Figure 1 may misleadingly suggest that only the positive-valence components of parent words were effective in yielding priming when recombined into *hulip*-type hybrid primes. The problem is that the proper midpoint of the EV scale is not numerical zero, but is determined by the proportion of positive-valence (i.e., pleasant) judgments that would be made in the absence of any priming effects. The midpoint is likely above zero because many subjects characteristically respond "pleasant" more often than "unpleasant."

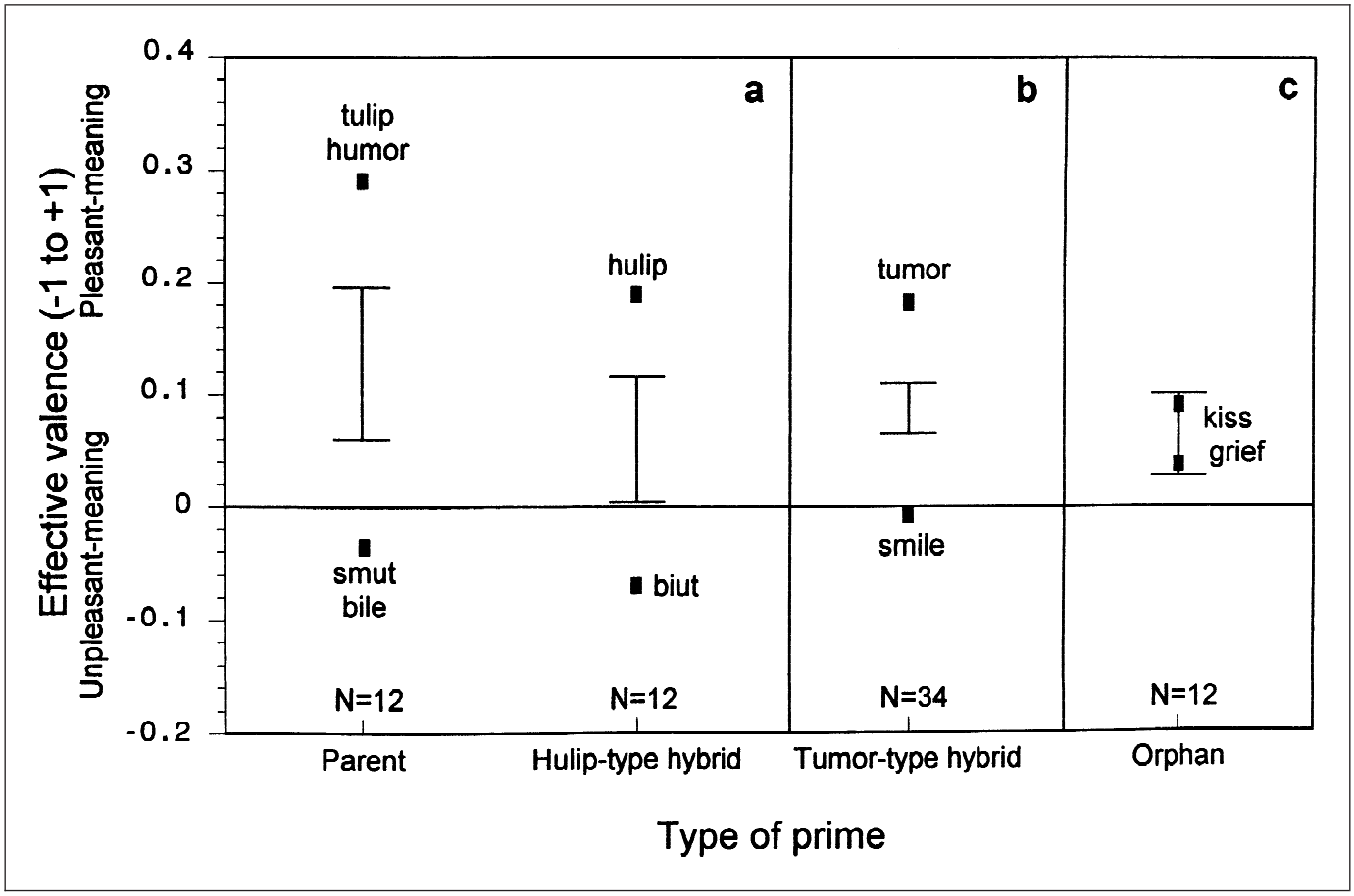

Fig. 1. Effects of four types of subliminal primes in Experiments 1 (a), 2 (b), and 3 (c). For each category of prime within the four types, effective valence was computed as the proportion of trials on which unpleasant targets were incorrectly classified as pleasant minus the proportion of trials on which pleasant targets were incorrectly classified as unpleasant. Parents were primes subjects had previously practiced classifying in their visible versions. *Hulip*-type hybrids were nonwords created from fragments of two same-valence parent targets that had previously been classified. *Tumor*-type hybrids were created similarly, but were themselves words with evaluative meaning opposite from the meaning of their two parents. Orphans were primes not viewed before previously as visible targets. Vertical bars indicate the magnitude of difference that is significant ($p = .05$, two-tailed). An example of each type of prime is shown.

that priming by nonword fragments was nearly at the same level as priming by previously classified words.

Analysis of combined priming and perceptibility data suggests that *hulip*-type hybrid primes produced priming under conditions in which they could not be consciously categorized. Data from the priming and perceptibility measures were combined by regressing the former measure onto the latter. Figure 2a shows priming by *hulip*-type hybrids regressed onto perceptibility of word primes in the perceptibility task. The critical result from this analysis is that the regression intercept representing the magnitude of priming associated with zero perceptibility of primes in the perceptibility task was significantly greater than zero (intercept = .326; $t[10] = 4.98$, $p = .001$). Following a logic developed in earlier work (Draine & Greenwald, 1998; Greenwald & Draine, 1997; Greenwald et al., 1995), we conclude that the *hulip*-type hybrid primes operated nonconsciously.[4]

EXPERIMENT 2

In showing that *hulip*-type hybrid primes effectively transmitted their parent words' valences, Experiment 1 demonstrated that unconscious analysis of word parts sufficed to enable significant subliminal priming. To follow up this finding, we designed Experiment 2 to provide direct comparison of the importance of whole-word and part-word information in subliminal primes. To do this, after making necessary modifications in the set of parent words, we recombined the parents to create 20 whole-word offspring that had evaluative meaning opposite to that of their parents. For example, *tulip* and *humor* can be combined to form *tumor*, the negative evaluative meaning of which is opposite to the positive evaluative meaning of its two parent words.

4. The assumptions underlying the regression analysis are discussed at length in comments that follow Draine and Greenwald's 1998 article (Dosher, 1998; Greenwald & Draine, 1998; Klauer, Greenwald, & Draine, 1998; Merikle & Reingold, 1998). With regard to these assumptions, we note here only that the combination of conditions that is likely to make application of the regression method problematic—substantial measurement error in the predictor (data points for the perceptibility task that fall well below zero) along with a positive regression slope and a mean on the predictor variable well above zero—are not found in any of the data sets in Experiments 1 through 3.

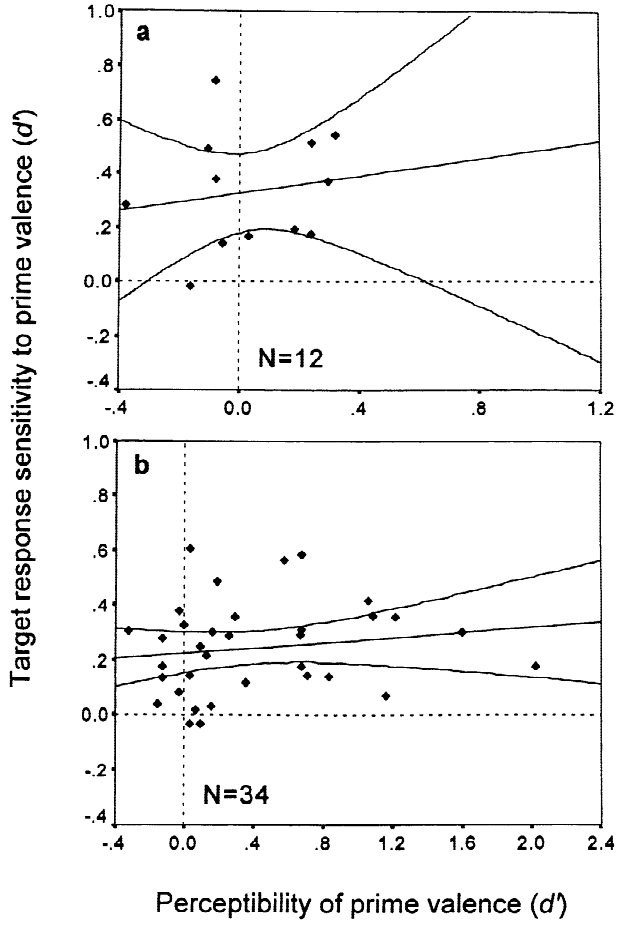

Fig. 2. Regression analyses for (a) *hulip*-type and (b) *tumor*-type hybrid primes. Data points represent individual subjects. The extent to which these hybrids functioned as primes with the valence of their parents is plotted as a function of perceptibility of the priming stimuli. For the calculations of sensitivity to prime valence, the hybrid primes were assigned the valence category of the earlier-classified parents from which they were formed. Thus, above-zero values of d' reflect hybrids acting with that valence (e.g., *smile* acting with the valence of the earlier-classified targets *smut* and *bile*), whereas below-zero values of d' reflect hybrids acting with their whole-word "face-value" valence. The regression function (with curves indicating its 95% confidence interval) shows the association between priming and perceptibility of primes. Priming is statistically significant and is interpreted as unconscious in operation when the curve for the lower 95% confidence interval passes above the origin.

We call this type of prime a *tumor-type hybrid*. Some other examples of *tumor*-type hybrids are *agony* (*agree* + *pony*), *crown* (*crime* + *frown*), and *smile* (*smut* + *bile*). Because *tumor*-type hybrid primes function in opposite fashion at part-word and whole-word levels, results of this experiment can indicate whether part-word or whole-word analysis is more potent in unconscious priming.

Subjects

Ten male and 24 female University of Washington undergraduates participated in exchange for either credit toward a course requirement or cash payment. All had normal or corrected-to-normal vision, were fluent in English, and were naive about the hypothesis of the experiment.

Procedure and Apparatus

The apparatus and procedure were similar to the apparatus and procedure in Experiment 1. Subjects received initial practice categorizing a set of 40 parent words, then completed the six critical priming blocks (40 trials per block) in which targets continued to be the original parent words and masked primes were drawn from the set of 20 *tumor*-type hybrid primes. (As in Experiment 1, the hybrid words used as primes never appeared as visible targets during the experiment.) Subjects then received practice in the perceptibility task and completed four blocks of that task (using only parent words as the masked stimuli that were to be categorized, in order to avoid interpretive difficulties associated with the competing levels of analysis possible for the *tumor*-type hybrid primes).

Results

Figure 1b shows that for the *tumor*-type hybrid primes, analysis of parts prevailed over whole-word meaning (e.g., *tumor*, from *tulip* + *humor*, acted as a pleasant-meaning prime; *smile*, from *smut* + *bile*, acted as an unpleasant-meaning prime). As in Experiment 1, this part-dominated priming appears to have occurred nonconsciously: The significant regression intercept in Figure 2b (intercept = .230, $t[32] = 6.06$, $p < .001$) indicates that priming by *tumor*-type hybrid primes was associated with zero perceptibility of primes in the perceptibility task. Thus, under conditions of visual masking that rendered the primes subliminal, part-word information (of the type demonstrated in Experiment 1) was more potent in priming than was whole-word information.

EXPERIMENT 3

Experiments 1 and 2 suggest that unconscious priming is driven not by analysis of whole-word meaning, but by subword components of primes acting with the valence of the targets in which they earlier appeared. To test this another way, we performed a third experiment in which primes shared little in the way of subword components with earlier targets. These primes (which had little relation at the subword level with any previously presented parent words) can be labeled *orphan primes* (i.e., lacking parent targets, in contrast with the primes in Experiments 1 and 2). Because orphan primes were never viewed or classified earlier in the experiment, and because their parts had not appeared in earlier targets, they could produce priming only if their whole-word meaning was analyzed. As a between-subjects variation, the same prime words were presented in the critical (orphan) condition in which they appeared only as primes (and never targets) and also in a control condition in which they served as both primes and targets.

Subjects

Twelve male and 15 female University of Washington undergraduates participated in exchange for credit toward a course requirement.

All had normal or corrected-to-normal vision, were fluent in English, and were naive about the hypothesis of the experiment.

Materials, Procedure, and Apparatus

The apparatus and sequence of events on trials were similar to the apparatus and sequence in Experiments 1 and 2. Prior exposure to primes as visible targets was manipulated as a between-subjects variable. The experimental (orphan) group ($n = 12$) first received practice with a set of 16 pleasant- and unpleasant-meaning visible parent targets. They then completed the six critical priming blocks (48 trials per block) in which visible targets continued to be drawn from the originally practiced set, but masked primes were a different set of 16 (orphan) words, 8 pleasant words and 8 unpleasant words chosen so as to share few subword elements with the already-practiced target words. This group of subjects then completed a perceptibility task in which the to-be-categorized masked words were the orphan primes from the priming task.

The control group ($n = 15$) received practice categorizing as visible targets the set of 16 words used as the primes in the orphan condition, and then completed priming blocks with those same words as both masked primes and visible targets. In the perceptibility task, these subjects again categorized the same masked words.

Results

Orphan primes were ineffective as subliminal primes, despite the fact that the same words yielded ample subliminal priming in the control condition. A comparison of priming, measured by EV, revealed a significant difference between orphan and control primes, $t(25) = 4.30$, $p < .001$. Figure 1c shows that priming as measured by EV was nonsignificant for orphan primes. Nor did orphan primes produce a significant regression intercept (Fig. 3a). In the control condition, the same words did yield a significant intercept, indicating priming that was associated with zero perceptibility of primes (Fig. 3b; intercept = .278, $t[13] = 4.85$, $p < .001$).

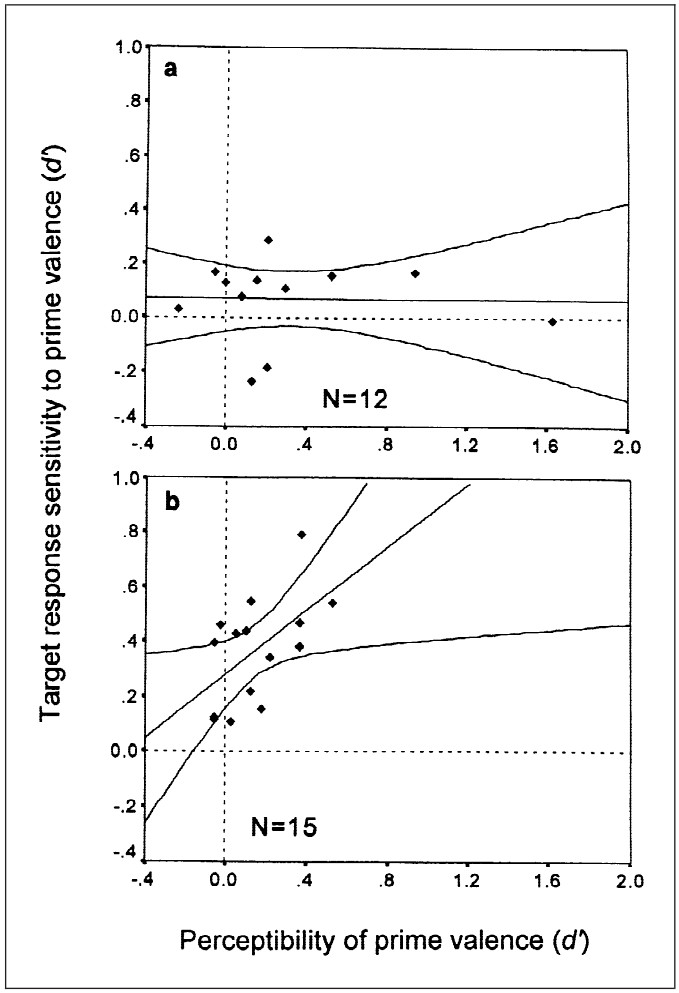

Fig. 3. Regression analyses for (a) orphans and (b) control primes. For one group of subjects, words that had not previously appeared as visible targets served as the masked primes (orphans). For a second group of subjects, as a control, those same words appeared as masked primes after having been viewed earlier as visible targets. See Figure 2 for an explanation of the regression analyses.

GENERAL DISCUSSION

In Experiment 1, significant unconscious priming was obtained with nonword primes composed of recombined parts of earlier-viewed (parent) targets. In Experiment 2, masked primes were also composed of recombined parts, but the parts formed words whose evaluative valence was opposite the valence of their parent targets. Despite their highly polarized whole-word evaluative meaning, these primes acted paradoxically with the valence of their parts. Together, these experiments characterize unconscious priming as (a) largely driven by the analysis of subword elements and (b) strongly influenced by recent experience with these subword components in the context of classifying visible target words that contain them. The experiments also suggest that unconscious priming only weakly, if at all, involves analysis at the level of whole-word meaning. Experiment 3 supported this latter conclusion by showing no significant priming when subjects had no prior experience classifying as targets the words that appeared as masked primes.

Although subjects never classified the orphan words in Experiment 3 as visible targets, it should be noted that they were exposed to those words repeatedly as masked primes. Nevertheless, no priming was obtained. Evidently the processing of masked primes does not suffice to enable later priming by those words in the same way that the processing of targets does. This finding is consistent with both the present results indicating limited analysis and recent research showing that the effects of unconscious activation by primes appear to be extremely short-lived (Greenwald et al., 1996).

The absence of priming from orphan primes in Experiment 3 does not justify a conclusion that no whole-word analysis takes place. The orphan primes in Experiment 3 may have received a limited degree of whole-word analysis (a possibility consistent with the fact that the regression intercept in Fig. 3a is nonsignificantly positive). Such limited analysis would be consistent with a pattern of findings in the literature: When primes have not been classified earlier as targets, so that priming requires whole-word analysis (as in the majority of published studies), unconscious priming has generally been associated with small effect sizes, and effects have been difficult to replicate (cf.

reviews in Draine & Greenwald, 1998; Forster, 1998). This has been true across a wide range of procedural variations, indicating that whole-word analysis does not occur strongly in unconscious priming, regardless of procedure. In contrast, strong effects have been obtained readily in procedures that enable priming on the basis of subword analysis alone (i.e., by presenting targets that reappear repeatedly as primes; Draine, 1997; Draine & Greenwald, 1998; Greenwald et al., 1996).[5] Overall, the pattern in the literature corresponds to the pattern of results in the present experiments: robust priming based on word parts, but unreliable priming based on whole-word meaning. The general picture is consistent with the view that analysis occurring mainly at the subword level is a basic, widely generalizable property of unconscious priming.

This important distinction between effective unconscious subword analysis of earlier-classified primes and ineffectual whole-word analysis of orphan primes may be related to similar phenomena involving unattended (nonmasked) words. For example, Broadbent and Gathercole (1990) examined a task in which spatially unattended flanking words had been demonstrated in earlier research to affect semantic classification of a central target word (Shaffer & LaBerge, 1979). In the earlier study, the effect of flanking words on responses to targets was interpreted as showing (automatic) semantic analysis of unattended stimuli (Shaffer & LaBerge, 1979). Shaffer and LaBerge's procedure involved a small set of words presented repeatedly as both targets and flanking words. Broadbent and Gathercole (1990) speculated that this repetition of items allowed flanking words to be identified by analysis of isolated features, rather than semantically. That flanking words were not analyzed semantically as whole words was supported by Broadbent and Gathercole's finding, which parallels results of our Experiment 3, that flanking words had no effect when new flanking words were selected for each trial. Thus, for various kinds of weakly processed stimuli, including masked as well as spatially unattended words, only limited analysis may be possible. But this limited analysis may suffice to produce effective activation after recent (attended) experience with the stimuli.

The present findings bear directly on an active debate about the analytic capabilities and limits of unconscious cognition (Greenwald, 1992; Kihlstrom, 1987; Loftus & Klinger, 1992). Advocates of contrasting positions in this debate appear to have agreed, over the past decade, that unconscious analysis operates at least at the level of individual whole-word meaning. A recent focus of research, therefore, has been whether any higher-level (multiword) analysis occurs (cf. the "two-word challenge" in Greenwald, 1992). For example, recent research has shown no evidence for unconscious processing of the meaning of compound words or the phrase-level meaning of simple two-word phrases (Draine, 1997). Our results here reposition the battle lines in this debate by seriously questioning the previous apparent consensus that effectively masked primes are analyzed at least at a whole-word level. Rather, it is now plausible that subliminal primes receive analyses that operate on no more than parts of words.

5. All of the studies of which we are aware that have used targets reappearing as primes have also used the response-window method (which certainly also has contributed to reliably obtaining large effect sizes). A reviewer of an earlier draft of this article has suggested that priming driven by subword analysis may be specific to procedures using obligatory rapid responding (e.g., the response-window method), because such responding encourages shallow processing of targets, and shallow processing of targets may extend to prime processing. However, this line of reasoning depends on an unestablished assumption that strategies applied to (presumably conscious) analysis of targets are automatically applied to (presumably unconscious) analysis of primes. Further, there is no evidence that the processing of targets in the present procedure is in fact shallow. The frequent repetition of targets makes it likely that their evaluative meaning can be accessed quickly. Even with relatively rapid responding (approximately 400 ms after target onset), these practiced targets are almost certainly analyzed to the point of extracting their whole-word evaluative meaning. It seems more likely that the role of rapid responding in producing larger effect sizes is its enabling use of a rapidly decaying representation of the masked prime.

Acknowledgments—This research was supported by National Science Foundation Grant SBR-9710172 and National Institute of Mental Health Grants MH41328, MH01533, and MH57672.

REFERENCES

Bellezza, F., Greenwald, A., & Banaji, M. (1986). Words high and low in pleasantness as rated by male and female college students. *Behavior Research Methods, Instruments, & Computers*, *18*, 299–303.

Broadbent, D., & Gathercole, S. (1990). The processing of non-target words: Semantic or not? *Quarterly Journal of Experimental Psychology: Human Experimental Psychology*, *42*, 3–37.

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

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

Dehaene, S., Naccache, L., Le Clech, G., Koechlin, E., Mueller, M., Dehaene-Lambertz, G., van de Moortele, P., & Le Bihan, D. (1998). Imaging unconscious semantic priming. *Nature*, *395*, 597–600.

Dosher, B. (1998). The response-window regression method—Some problematic assumptions: Comment on Draine and Greenwald (1998). *Journal of Experimental Psychology: General*, *127*, 311–317.

Draine, S. (1997). *Analytic limitations of unconscious language processing*. Unpublished doctoral dissertation, University of Washington, Seattle.

Draine, S., & Greenwald, A. (1998). Replicable unconscious semantic priming. *Journal of Experimental Psychology: General*, *127*, 286–303.

Forster, K. (1998). The pros and cons of masked priming. *Journal of Psycholinguistic Research*, *27*, 203–233.

Greenwald, A. (1992). New Look 3: Unconscious cognition reclaimed. *American Psychologist*, *47*, 766–779.

Greenwald, A., & Draine, S. (1997). Do subliminal stimuli enter the mind unnoticed? Tests with a new method. In J. Cohen & J. Schuler (Eds.), *Scientific approaches to consciousness: 25th Carnegie Symposium on Cognition* (pp. 83–108). Hillsdale, NJ: Erlbaum.

Greenwald, A., & Draine, S. (1998). Distinguishing unconscious from conscious cognition—Reasonable assumptions and replicable findings: Reply to Merikle and Reingold (1998) and Dosher (1998). *Journal of Experimental Psychology: General*, *127*, 320–324.

Greenwald, A., Draine, S., & Abrams, R. (1996). Three cognitive markers of unconscious semantic activation. *Science*, *273*, 1699–1702.

Greenwald, A., Klinger, M., & Schuh, E. (1995). Activation by marginally perceptible ("subliminal") stimuli: Dissociation of unconscious from conscious cognition. *Journal of Experimental Psychology: General*, *124*, 22–42.

Hirshman, E., & Durante, R. (1992). Prime identification and semantic priming. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *18*, 255–265.

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.

Johnston, W., & Dark, V. (1986). Selective attention. *Annual Review of Psychology*, *37*, 43–75.

Kihlstrom, J. (1987). The cognitive unconscious. *Science*, *237*, 1445–1452.

Klauer, K., Greenwald, A., & Draine, S. (1998). Correcting for measurement error in detecting unconscious cognition: Comment on Draine & Greenwald (1998). *Journal of Experimental Psychology: General*, *127*, 318–319.

Klauer, K., & Musch, J. (1998, May). *Evidence for no affective priming in the naming task*. Poster presented at the annual meeting of the American Psychological Society, Washington, DC.

Loftus, E., & Klinger, M. (1992). Is the unconscious smart or dumb? *American Psychologist, 47*, 761–765.

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

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

Merikle, P., & Reingold, E. (1998). On demonstrating unconscious perception: Comment on Draine & Greenwald (1998). *Journal of Experimental Psychology: General, 127*, 304–310.

Morton, J. (1969). The interaction of information in word recognition. *Psychological Review, 76*, 165–178.

Shaffer, W., & LaBerge, D. (1979). Automatic semantic processing of unattended words. *Journal of Verbal Learning and Verbal Behavior, 18*, 413–426.

Treisman, A. (1960). Contextual cues in selective listening. *Quarterly Journal of Experimental Psychology, 12*, 242–248.

(RECEIVED 4/6/99; ACCEPTED 7/22/99)