LIMITED UNCONSCIOUS PROCESS OF MEANING

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Abstract

In two experiments, subjects' task was to decide whether a binocularly viewed target word was evaluatively good (e.g., fame, comedy, rescue) or bad (e.g., stress, detest, malaria) in meaning. Just prior to this target word, a priming word was presented to the nondominant eye, and masked by an immediately following presentation of a letter-fragment pattern to the dominant eye. (Masking effectiveness was demonstrated by subjects' failure to discriminate the left vs. right position of a test series of words.) In Experiment 1, which used evaluatively positive or negative words as priming stimuli, judgment latency for the evaluative decision task was facilitated by primes that agreed in evaluation with targets, and was retarded by primes that disagreed in evaluation with targets. This result demonstrated that the evaluative meaning of priming stimuli was processed under conditions that prevented subjects from detecting their presence. Primes in Experiment 2 were 2-word strings for which the evaluative meaning of individual words was orthogonal to the evaluative sentence meaning (e.g., the two evaluatively negative words, "enemy fails," make up an evaluatively positive sentence). Results of Experiment 2 indicated that masked priming effects were influenced by the evaluative meanings of individual words, but not by their sentence meanings. This result supported the conclusion that the processing of undetected, dichoptically masked words is limited to analyses that are not powerful enough to extract sentence meanings.

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RUNNING HEAD: Limited Unconscious Processing

Limited Unconscious Processing of Meaning

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Detectionless processing can be defined as processing of information from displays that subjects cannot detect. This can be contrasted with attentionless processing, defined as processing information from displays that, although detectable, cannot be recalled or recognized. The occurrence of attentionless processing has been well established by a variety of procedures. Whether or not any form of detectionless processing can occur, however, remains a matter of controversy. A variety of claimed detectionless processing findings have been criticized either because they stand as isolated, nonreplicated findings, or because they do not conclusively establish nondetectability of the processed stimulus.

Against this background of unresolved controversy, one recently used procedure offers promise of providing a replicable, conclusive demonstration of detectionless processing. In three studies that used it, this finding has been described as demonstrating "unconscious perception" (Marcel, 1983a), "lexical access without awareness" (Fowler, Wolford, Slade, & Tassinary, 1981), or "automatic semantic activation" (Balota, 1983). All three of these studies used a procedure in which each trial of a lexical decision task -- that is judging whether or not a letter string is a word -- was preceded by a priming stimulus that was backward-masked to prevent detection. The masking technique of all three studies -- known as central masking (Turvey, 1973) -- involved presenting a test stimulus to the nondominant eye, followed rapidly by a patterned array to the dominant eye. The interval between test stimulus and pattern mask was adjusted for each subject to a value at which the subject could not discriminate between trials in which a letter string was or was not presented as the test stimulus. Prior resarch (Meyer & Schvaneveldt, 1971) has shown that positive lexical decisions are facilitated (or primed) by prior presentation of a semantically associated word. Marcel (1983a, Exp. 4) showed that this priming effect was as strong when the priming word was centrally masked as when it was normally visible. Both Fowler et al. (1981) and Balota (1983) replicated Marcel's finding.

Although the Marcel, Fowler et al., and Balota findings make a strong case for detectionless processing, two criticisms of this group of three studies have been raised. Both criticisms have to do with threshold-setting procedures. Holender (in press; see also Purcell, Stewart, & Stanovich, 1983)) suggested that the three studies used an insufficiently stringent procedure to set detection thresholds. Cheesman and Merikle (in press) observed that the threshold-setting procedures of the three studies may have located "subjective," rather than objective, thresholds. That is, subjects may report that they see nothing even when a d' measure of signal detectability would indicate that stimulus information actually was being detected.

Although it is difficult to evaluate precisely the extent to which the criticisms that have been made actually apply to the three studies, still these criticisms have successfully raised doubt as to whether or not detectionless processing has been demonstrated. In seeking a more conclusive verdict regarding detectionless processing, the present research

used more stringent procedures for threshold setting. In particular, to test for detectability during threshold setting, a left-right position discrimination was substituted for the yes-no detection judgment previously used. Additionally, a threshold value was accepted only when subjects' position-discriminating performance fell below the level of chance accuracy. Another innovation in the present research was replacement of the lexical decision task of the previous studies with an evaluative decision task. For this evaluative decision task, subjects were asked to judge whether a presented (target) word was evaluatively good or bad in meaning. Evaluatively polarized preliminary words should produce substantial priming effects, given that evaluation is a primary component of word meaning (Osgood, Suci, & Tannenbaum, 1958).

Experiment 1

Method

Subjects. Subjects were 20 male and female volunteers who participated in partial fulfillment of a requirement of their introductory psychology course.

Apparatus. Stimuli were presented via a Gerbrands 3-field tachistoscope, which was modified by addition of a low-luminance light-emitting diode as a permanent fixation point. The prime and mask fields contained polarizing filters, which were oriented so that the prime field was presented only to the subject's nondominant eye, and the mask field was presented only to the dominant eye. A foot switch was used by the subject to start trials. Stepping on the foot switch initiated a 0.5-s interval before the tachistoscope sequence started. Two pushbutton switches, mounted on a small box, were used to indicate responses with the subject's left and right forefingers.

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Threshold determination. Threshold determination used a set of test stimuli consisting of a random series of the words RIGHT or LEFT, positioned randomly either just left or just right of the central fixation point. The subject was asked to press the left or right button, depending only on whether the test stimulus was seen to the left or right of center, and to guess if uncertain. For the first six trials, the test stimulus-to-mask interval was 210 ms, which permitted all subjects to see the test stimulus clearly. This interval was reduced, in successive blocks of six trials, to 110 ms, 80 ms, 60 ms, 30 ms, 25 ms, 22 ms, then reduced further in 1 ms decrements until the subject produced at least 4 errors in one of these blocks of 6 trials. At that point, 24 more trials were conducted without changing the dark interval's duration. A stimulus-mask interval was considered usable if the subject produced at least 12 errors in the final 24 trials. (Otherwise, the interval was further reduced and testing was continued.) The final stimulus-mask onset intervals ranged from 15 to 25 ms across the 20 subjects. This procedure, which required no more than 47% correct, compared with the chance expected value of 50%, was considered to be a conservative one that was prone to err by selecting a low detection threshold.

SLIDE 1

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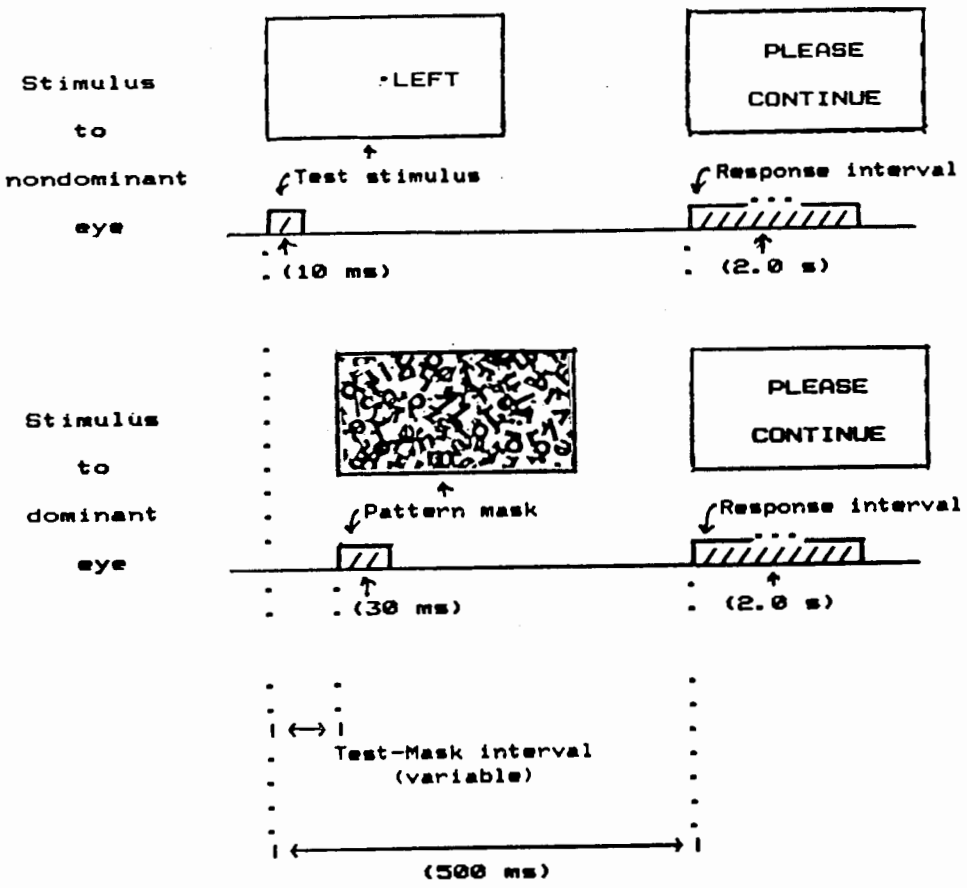
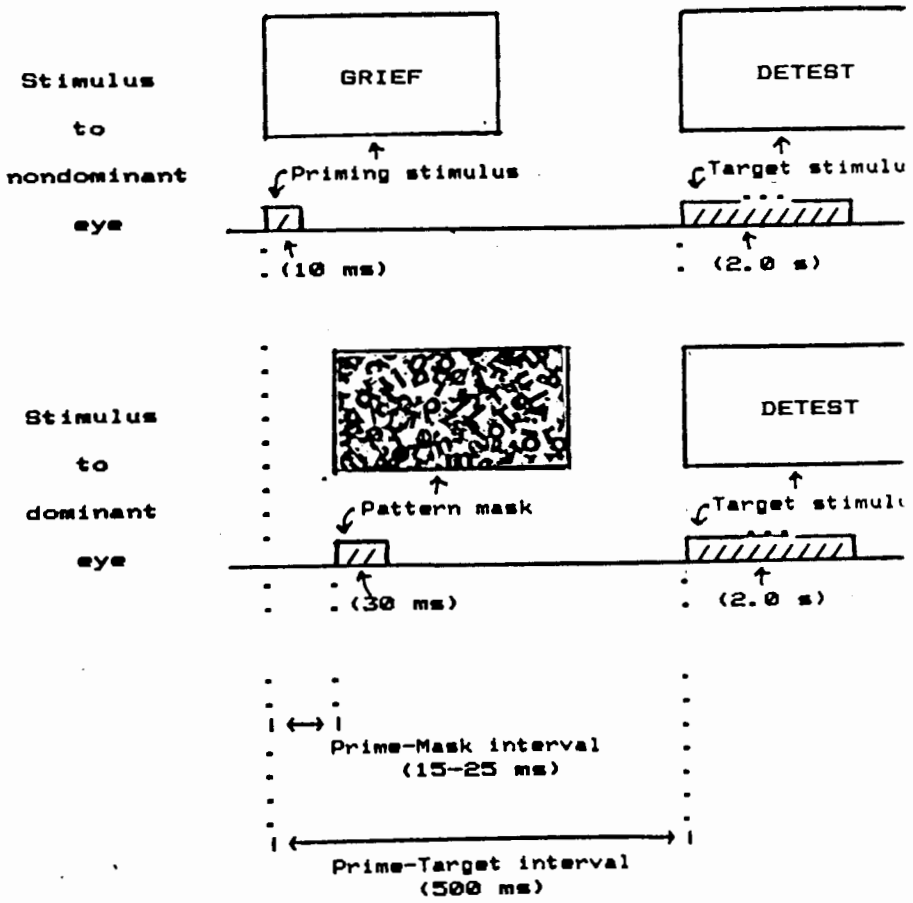
PROCEDURE FOR THRESHOLD SETTING



SLIDE 2

2

PROCEDURE FOR PRIMING BY CENTRALLY MASKED WORDS



SLIDE 2

Evaluative decision task -- masked priming trials. After completion of the threshold-setting phase, the subject was told that, on each trial, there would be an initial flash, following which a word would be presented. That word was to be judged as evaluatively good or bad in meaning, by pressing the right or left response button, respectively, as rapidly as possible. Six types of trials were constructed by combining the three types of primes (positive, neutral, and negative) with the two types of targets (positive and negative).

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Unmasked priming. Unmasked trials consisted also of prime, mask, and target stimuli, separated by dark intervals. However, the prime was presented to both eyes and its duration was increased to 210 ms.

The masked condition was always presented first, so that subjects would not be alerted to the inclusion of varying, evaluatively polarized words in the masked condition's trial-beginning flash. At the conclusion of the experiment, subjects were interviewed informally to determine whether or not they had been able to detect words in the initial flashes of masked trials. All subjects indicated that they had not been aware of such words.

Results and Discussion

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Obtained priming effects consisted of both facilitation and interference effects, with the facilitation effects being stronger. However, there was no interference effect for the combination of positive primes and negative targets in the unmasked condition.

The main aim of Experiment 1 was to test for detectionless processing, using a stringent criterion for nondetectability of masked stimuli. That aim was achieved. Because the masked priming procedure yielded strong evidence of priming effects, the conclusion of detectionless processing should now be regarded as more strongly established than before. In particular, it is not apparent how the criticisms raised by Holender (in press), and by Cheesman and Merikle (in press) could apply to the procedures used to obtain the present findings.

Experiment 2

Experiment 1 indicated that detectionless processing could extract evaluative meanings of words. Experiment 2 was designed to determine whether detectionless processing could perform a more complex operation -- namely, extracting the evaluative meanings of sentences.

Construction of Priming Stimuli

Consider hero wins as an example of a 2-word sentence having evaluative

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EVALUATIVE DECISION TASK

SINGLE-WORD PRIMES, SINGLE-WORD TARGETS

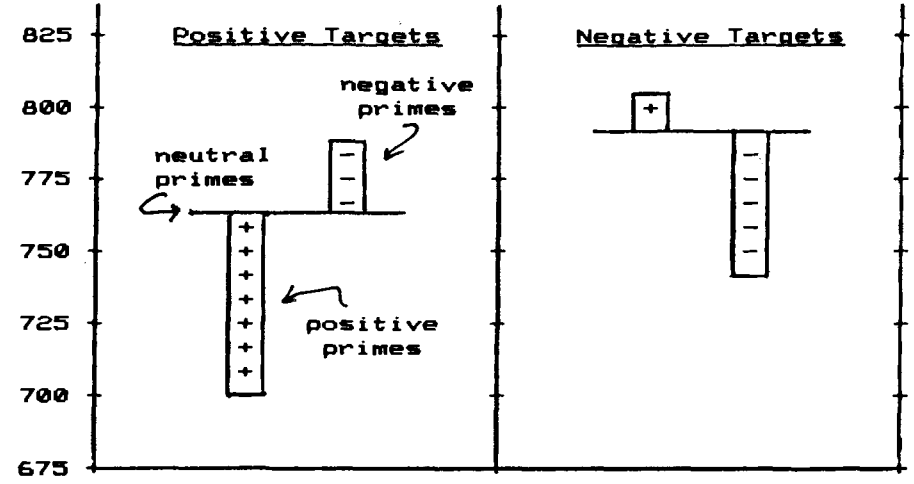
Sample Prime	Type of pair (Prime/target)	Sample Target
HAPPY (+)	+ / +	VICTORY (+)
STREET (0)	0 / +	HONOR (+)
GLOOM (−)	− / +	POETRY (+)
NICE (+)	+ / −	DIVORCE (−)
DOOR (0)	0 / −	AFRAID (−)
UGLY (−)	− / −	SNOB (−)

SLIDE 4

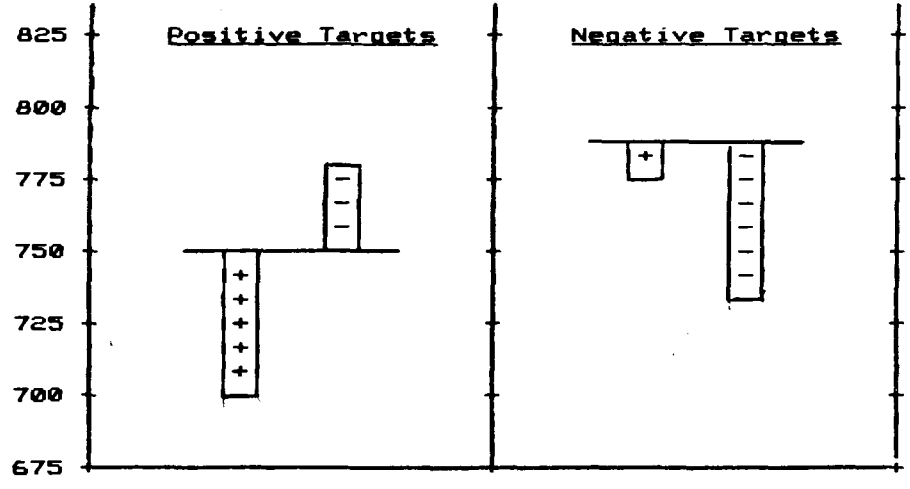
RESULTS OF DETECTIONLESS PROCESSING EXPERIMENT 1

(REACTION TIMES IN MSEC -- N = 20)

MASKED PRIMING CONDITION



ORDINARY (NONMASKED) PRIMING CONDITION



meaning -- which is positive. Of course, the individual words in this sentence (hero and wins) are also evaluatively positive. If hero wins, when centrally masked to be undetectable, functions as an evaluatively positive prime, that could be due either to analysis of its individual words' evaluative meanings or to analysis of its sentence meaning. In contrast, enemy fails has opposite evaluative meanings when analyzed as a sentence and when analyzed as individual words. That is, as a sentence, enemy fails is evaluatively positive, but it consists of two evaluatively negative words. If enemy fails functions as an evaluatively positive prime when masked to be undetectable, strong evidence for detectionless analysis of sentence meaning would be obtained. On the other hand, finding that enemy fails functions as an evaluatively negative prime would support the conclusion that detectionless processing cannot analyze sentences.

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Two-word stimuli were constructed by using positive or negative sentence subjects and positive or negative verbs (3 of each) in all possible combinations.

Procedure

Subjects. Data were obtained from 20 male and female volunteers from the same population used for Experiment 1.

Threshold-setting. The threshold setting procedure was slightly altered from that of Experiment 1. After missing 4 or more of a groups of 6 trials at a given test stimulus-mask interval, 18 (rather than 24) further trials were conducted, with the stipulation that subjects must miss at least 10 of these 18 (rather than 12 of 24). Subjects were obliged, in other words, to perform at no more than 42% correct over a series of 24 trials.

Masked priming -- single-word primes, sentence targets. In the first series of trials, the 2-word sentences were used as targets (not as primes), and evaluatively positive and negative single words served as masked primes. Subjects were asked to interpret the 2-word stimuli as sentences in judging their evaluative meaning. This procedure was intended mainly to familiarize subjects with the sentence stimuli that would later be used as priming stimuli; it also provided a replication test of the masked priming effect obtained in Experiment 1.

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this should be "prime-target" interval

Masked priming -- sentence primes, single-word targets. The mask-prime interval was increased to 750 ms for this condition.

Unmasked priming -- sentence primes, single-word targets. For unmasked priming, the duration of the 2-word primes was increased from 10 ms to to 210 ms.

Results

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SLIDE 5

EVALUATIVE DECISION TASK

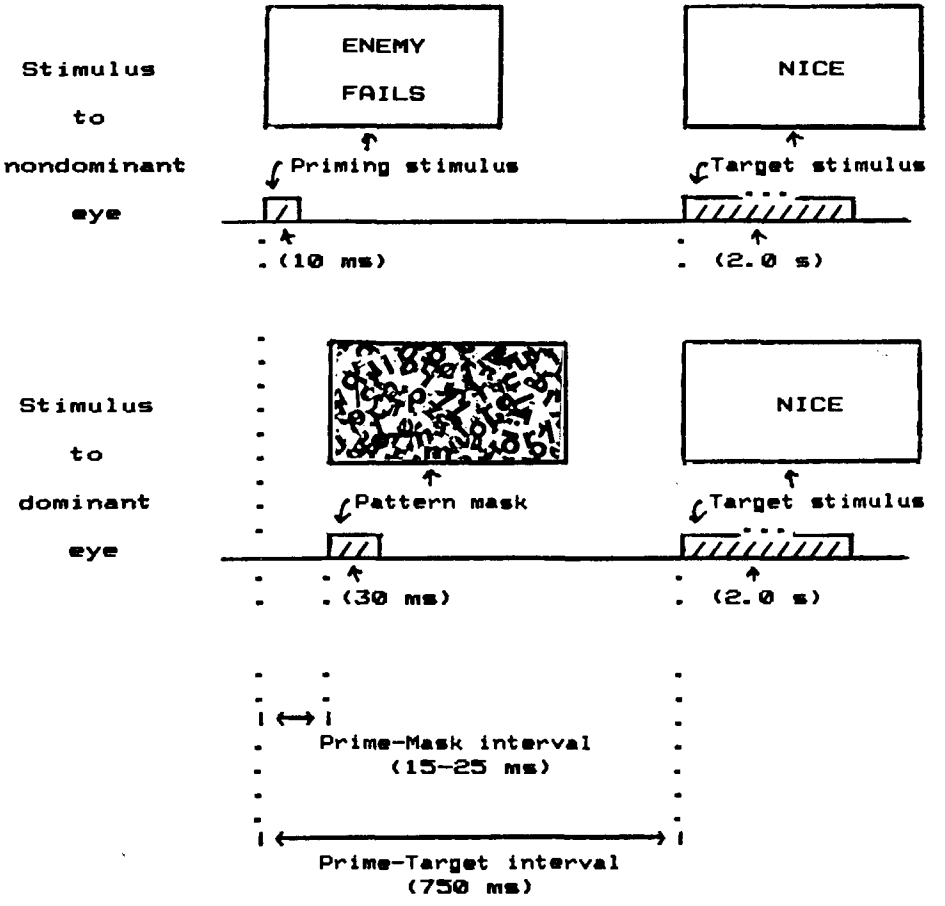
TWO-WORD PRIMES, SINGLE-WORD TARGETS

Sample Prime	Type of pair (Prime/target)	Sample Target
FRIEND SUCCEEDS (+) (+)	(+,+)/ +	BEACH (+)
OPPONENT LOSES (−) (−)	(−,−)/ +	WARMTH (+)
HERO FAILS (+) (−)	(+,−)/ +	GIFT (+)
VILLAIN WINS (−) (+)	(−,+)/ +	GLORY (+)
PARTNER WINS (+) (−)	(+,+)/ −	DEATH (−)
ENEMY SUFFERS (−) (−)	(−,−)/ −	IDIOT (−)
FRIEND LOSES (+) (−)	(+,−)/ −	AFRAID (−)
ENEMY PROSPERS (−) (+)	(−,+)/ −	THIEF (−)

SLIDE 6

PROCEDURE FOR PRIMING BY CENTRALLY MASKED WORDS

(SENTENCE PRIME VARIATION)

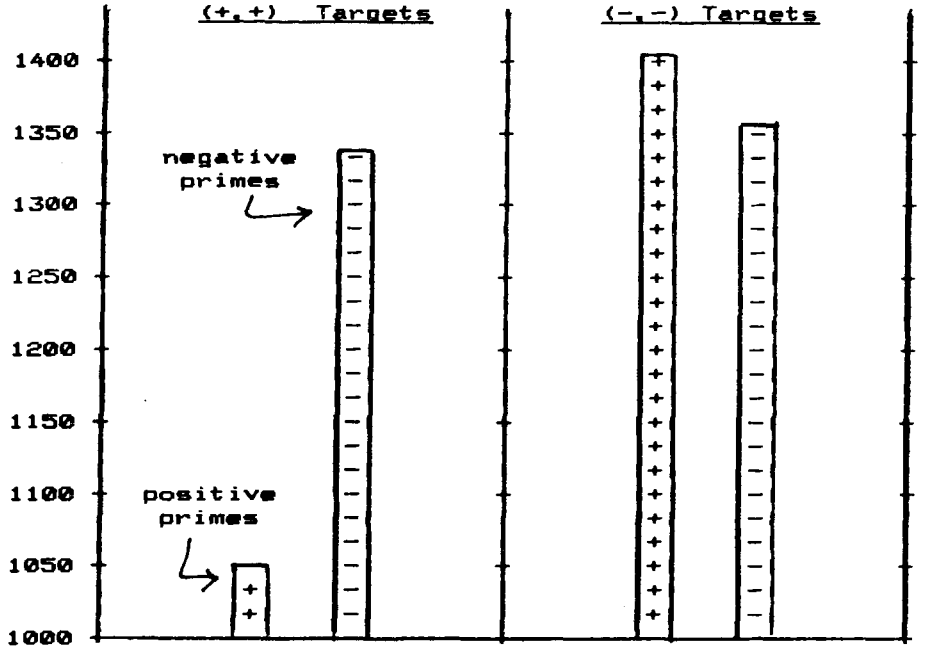


SLIDE 7

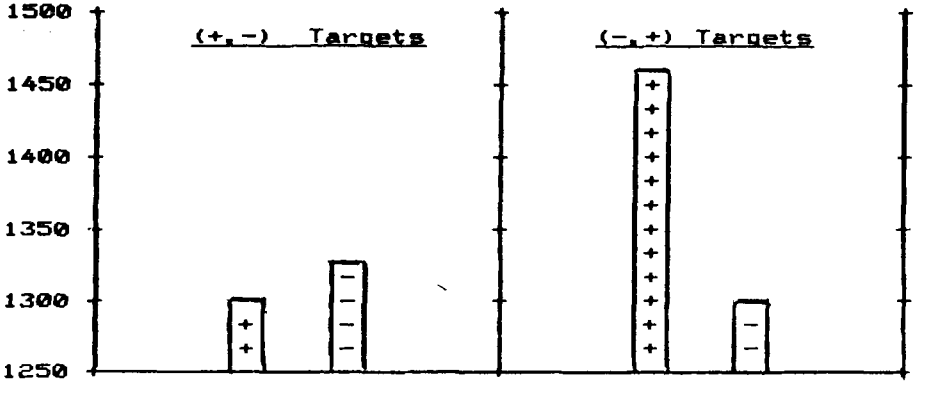
RESULTS OF DETECTIONLESS PROCESSING EXPERIMENT 2

(REACTION TIMES IN MSEC -- N = 20)

SINGLE-WORD PRIMES, SENTENCE TARGETS CONDITION



ORDINARY (NONMASKED) SENTENCE PRIMING CONDITION

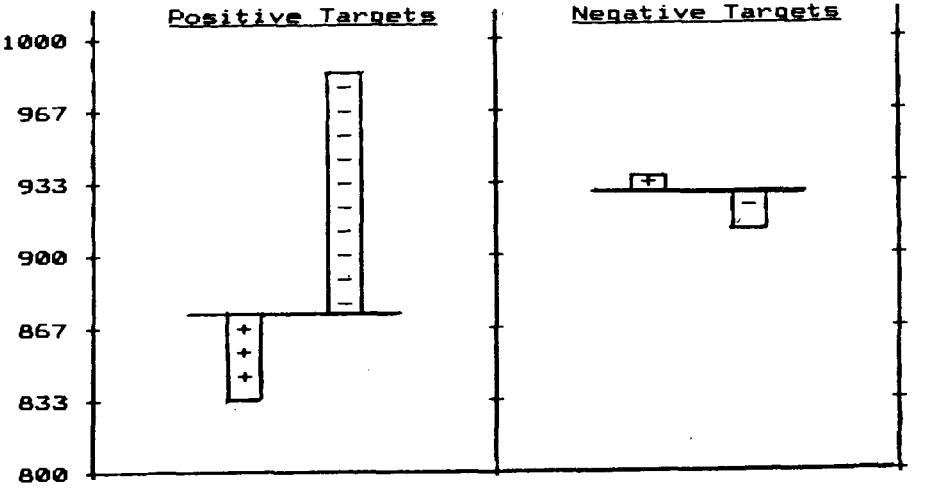


SLIDE 8

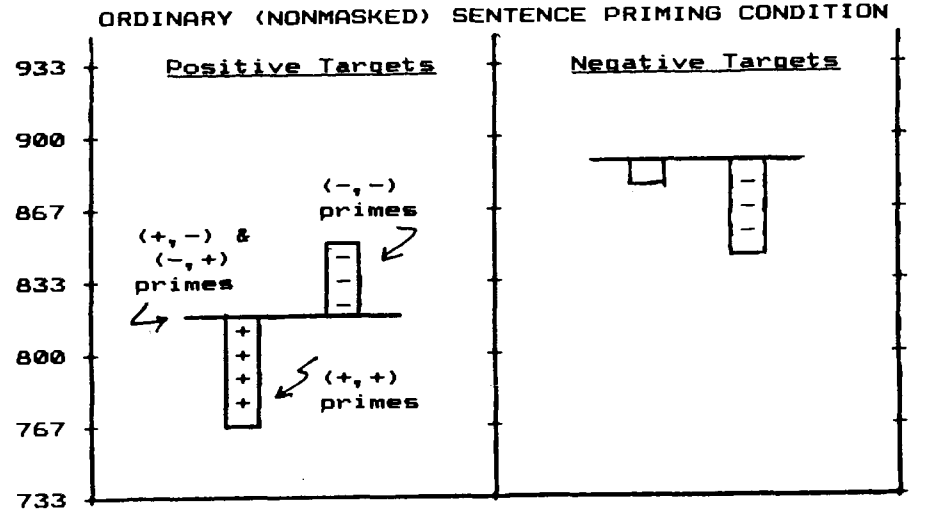
RESULTS OF DETECTIONLESS PROCESSING EXPERIMENT 2

(REACTION TIMES IN MSEC -- N = 20)

MASKED SENTENCE PRIMING CONDITION



ORDINARY (NONMASKED) SENTENCE PRIMING CONDITION



Masked single-word primes, sentence targets. Two of the four tests provided by the sentence judgment data yielded significant masked priming effects, with the one for positive subject-positive verb sentences being especially large.

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Masked sentence primes, single-word targets. For positive targets, fastest reaction times were obtained with priming by positive subject-positive verb combinations, and slowest reaction times were obtained with priming by negative subject-negative verb combinations. These results are consistent with the negative-negative pair functioning as a negative prime. For negative targets, the data provided a less clear picture. However, the negative-negative pair was the only prime for which judgments of negative targets were faster than judgments of positive targets.

Unmasked sentence primes, single-word targets. The pattern of mean reaction times was similar to that for the masked priming trials. Apparently, even when not masked, the negative-negative pairs functioned as evaluatively negative primes.

Discussion

Detectionless Processing

Added to others' findings of detectionless processing, the present findings appear to establish this phenomenon conclusively. The findings of Experiment 1, supported by the occurrence of further masked priming effects in Experiment 2, directly meet the two criticisms that have been raised in response to previous experiments that used the central masking procedure.

One of the criticisms of previous studies was that changes in illumination levels and changes in patterns of illumination shifts within trials could alter thresholds between the initial threshold-setting procedure and the later test of masked priming effects (Holender, in press; Purcell et al., 1983). In the present experiments, this criticism was averted by using identical illumination levels and within-trial illumination changes during both threshold setting and tests of masked priming.

The second criticism of previous studies was that threshold setting procedures may have selected exposure durations at which, despite subjects' reports of not seeing test stimuli, some stimulus detection occurred (Cheesman & Merikle, in press). In the present experiments, strong evidence that primes were objectively undetectable was provided by using a right-left position discrimination test that did not depend on self-reported awareness of seeing the test stimuli. This strategy was further supplemented by using a conservative criterion that selected a threshold exposure duration only when subjects' position-discrimination performance fell below chance accuracy.

Limited Detectionless Processing

The findings of Experiment 2 bear on theoretical questions concerning the

nature of processing of centrally masked stimuli. The results were consistent with the conclusion that evaluative decisions are primed only by the individual word meanings of 2-word strings, rather than by their sentence meanings. Additional research will be needed to characterize more precisely the limitations in capabilities of processing operations that are applied to nondetectable words.

It must be noted, however, that even visible (unmasked) 2-word stimuli appeared to function as primes in terms of individual word meanings, rather than in terms of their sentence meanings. Possibly, the priming of evaluative decisions is affected only by low-level stimulus analyses even when the priming stimuli are consciously accessible. An alternative possibility is that extraction of the positive evaluative meaning of a sentence such as enemy fails requires more time than was permitted by the 750-ms priming interval used in Experiment 2.

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