Notes and Comment

Detectionless processing with semantic activation? A footnote to Greenwald, Klinger, and Liu (1989)

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Recently published research has suggested that, in a pattern masking task, semantic activation caused by the target may continue to exist even though subjects cannot detect the target. The experiments are reassessed as an exceptional case of the more general rule that subjects are able to use residual semantic activation to actually detect targets. Furthermore, residual graphic information is far less effective at supporting near-chance target detections.

In a recent paper that appeared in this journal, Greenwald, Klinger, and Liu (1989) presented findings from three experiments. They claimed the following:

Coupled with previous research by others using the lexical decision task, these findings converge in establishing the reliability of the empirical phenomenon of semantic processing of words that are rendered undetectable by *dichoptic* pattern masking. (p. 35)

Facilitation of lexical decision by the "detectionless processing" of a prime is essentially the same claim as that made by Marcel (1983a, 1983b) and Fowler, Wolford, Slade, and Tassinary (1981). What makes Greenwald et al.'s paper important is the considerably greater rigor with which they establish the nondetectability of stimuli.

Notwithstanding these positive findings, others have found no evidence for detectionless processing. For instance, Cheesman and Merikle (1984, 1986) have argued for the distinction between a subjective and an objective (detectionless) assessment of whether stimuli are unconscious. They found that presentations that had used a subjective assessment showed evidence of high-level activation, whereas the "objective" assessment did not. Summarizing this and other evidence, Doyle and Leach (1988) hypothesized that

semantic activation of words is used to make (some) detections. . . . A d' of zero would only be possible if there were no semantic activation, for if there were semantic activation in the absence of graphic activation, subjects might use the semantic activation to make detection responses, thus pushing d' above zero. (p. 295)

Yet Greenwald et al. claim to have found semantic activation when $d' = 0$. The purpose of the present note is

to show how these apparently contradictory findings are actually entirely consistent.

Greenwald et al. used a two-alternative forced-choice position judgment to determine whether or not stimuli were detected. Words appeared either to the left or to the right of a fixation point. Subjects responded by pressing one of two buttons, the left button if they thought the target appeared to the left of fixation and the right button if they thought it appeared to the right. The particularly interesting manipulation was that the words LEFT and RIGHT appeared to the left or right of fixation: On half of the test trials, they were on the "correct" side of fixation (*consonant* presentation); on the other half, they were on the "incorrect" side of fixation (*nonconsonant* presentation).

Clearly, if no semantic activation occurs at $d' = 0$, it could make no difference whether the word LEFT was presented to the left of fixation or to the right of fixation, and the same holds true for the word RIGHT. However, there was an asymmetry, indicating not only that semantic activation was present but also that the semantic activation was able to affect a voluntary response. This is different from the customary method of observing semantic activation indirectly (e.g., through its ability to prime another word).

Let us assume a simple additive model, in which s is the strength of the semantic information and g is the strength of the graphic information in making detections, measured relative to the 50% baseline of chance responding. Consonant trials should yield performance of $(50 + g + s)\%$ correct; nonconsonant trials should yield $(50 + g - s)\%$ correct. Overall, an equal number of consonant and nonconsonant trials were presented, so that overall detections should be their average [i.e., $(50 + g)\%$]. From the averages given in Greenwald et al.'s (1989) Results subsections "Masked distractor effects on position judgments" (pp. 38, 40, and 42), we can compute s and g . These calculations are performed for their three experiments in Table 1. In their Experiment 1, "the procedures obliged performance to be at least slightly below chance" (p. 38), but was only assessed prior to the presentation of priming trials. The asterisked figures are therefore estimates. In Experiments 2 and 3, checks for adaptation effects were made in the middle of and after the priming trials, and exact overall performance figures are given.

It is interesting to note that s is about three times more effective in facilitating detections than is g , a finding that lends some support to Marcel's original claim (labeled hypothesis H1 in Doyle & Leach, 1988) that, as target-mask SOA was reduced, semantic judgments about a masked word could be sustained much better than could graphic judgments.

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Table 1
Estimating Detectability of Consonant Presentations for
Greenwald, Klinger, and Liu (1989)

	Experiment 1	Experiment 2	Experiment 3
Nonconsonant (50 + $g-s$)	42.2 (100-57.8)	47.2 (100-52.8)	46.2 (100-53.8)
Overall Average (50 + g)	50.0*	51.4	52.0
g	0.0*	1.4	2.0
s	7.8*	4.2	5.8
Ratio s/g		3.0	2.9
Consonant (50 + $g+s$)	57.8*	55.6	57.8
KR adjusted ($\times 1.72$)	63.4*	59.6	63.4

Note— g = strength of the graphic information in making detections; s = strength of the semantic information in making detections; KR = knowledge of results.

*Estimate.

Detectability for presentations in which both g and s can be used to support a correct response is given by $(50+g+s)$. Furthermore, Doyle and Leach found that supplying knowledge of results (KR) increased levels of detectability by a factor of 1.72, relative to baseline chance performance. If we use this KR multiplier to extrapolate the level of performance that might have been attained in the presence of KR, we arrive at the final row of Table 1. In other words, given a slightly different procedure for determining detectability, Greenwald et al.'s subjects may have attained more than 60% correct detections. This extrapolated level of performance, and Greenwald's demonstration of semantic priming with it, would then be consistent with Cheesman and Merikle's findings that semantic effects occur only when detectability (as measured by them) is above chance, not when it is at chance.

Greenwald et al.'s findings are also consistent with Doyle and Leach's hypothesis that semantics are used to support the detection response and that, under normal circumstances, $d' = 0$ is achieved only when semantic activation is obliterated. However, by clever manipulation, Greenwald et al. have made semantic activation interfere with the detection response on as many trials as it facilitates and thus, by a canceling effect, have left only the graphic component in their measured detectability.

It is clear that to-be-detected targets in backward-pattern-masking experiments can undergo high-level processing. Once this is accepted, it becomes a tenable position that detectability may be influenced by a multitude of factors, such as the semantics of the targets, the way the response is elicited, the particulars of the mask itself, and the nature of the discrimination task, each of which may affect different components of the processing. Experiments described briefly in Doyle (1988) bear out this contention.

It follows that experiments that assess a detectability criterion using one procedure and that assume it is an ade-

quate measure of detectability elsewhere in the experiment where a different procedure is applied are inherently difficult to control. Detectability is highly specific to the procedures used to assess it, and, furthermore, detectability space is highly contoured, in that small differences in procedure can make large differences in detectability. On the positive side, manipulations of detectability must correspond to manipulations of the underlying visual/cognitive processes, which means that psychologists have a new tool to investigate these mysterious processes.

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(Manuscript received June 28, 1989;
accepted for publication August 29, 1989.)