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Notes and Comment

Unconscious perception revisited

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In 1960, Eriksen reviewed a large number of studies that seemed to demonstrate perception without awareness and reached the following conclusion:

> At present there is no convincing evidence that the human organism can discriminate or differentially respond to external stimuli that are at an intensity level too low to elicit a discriminated verbal report. In other words, a verbal report is as sensitive an indicator of perception as any other response that has been studied (Eriksen, 1960, p. 298).

While this conclusion has certainly not been universally accepted (e.g., Dixon, 1971), there has been little reported evidence during the intervening years which seriously challenges its validity. However, this situation has recently changed. The results from a number of investigations (Fowler, Wolford, Slade, & Tassinary, 1981; Marcel, 1980, Note 1, Note 2; McCauley, Parmelee, Sperber, & Carr, 1980) appear to indicate that differential responses to masked visual stimuli can be obtained under viewing conditions in which it is impossible for subjects to make discriminated verbal reports. This apparent dissociation between verbal reports and other responses to masked visual stimuli contradicts Eriksen's (1960) earlier position, and the aim of this note is to provide a critical evaluation of these recent studies to determine if, in fact, rejection of Eriksen's conclusion is warranted at this time.

Many of the recent visual masking studies that appear to demonstrate perception without awareness use a backward-masking paradigm in conjunction with a semantic priming procedure. There are usually two mask conditions: no mask and pattern mask. The no-mask condition serves as a baseline, and it involves replication of the well-documented facilitation in reaction time (RT) that occurs when the presentation of a target stimulus is preceded by the presentation of a semantically related priming stimulus (e.g., Meyer, Schvaneveldt, & Ruddy, 1975). The pattern-mask condition, on the other hand, provides the critical observations. A masking stimulus that functions as a central mask (cf. Turvey, 1973) is used to provide sufficient degradation of the priming stimulus so that either presence-absence decisions are no better than chance (Fowler et al., 1981; Marcel, 1980, Note 1, Note 2) or identification of the primes is not possible (McCauley et al., 1980). The surprising result found in these studies is that semantic-priming effects are virtually unaffected by the masking stimulus. Thus, even though the masking stimulus eliminates discriminated verbal reports, the priming stimuli continue to facilitate both lexical decisions (e.g., Fowler et al., 1981; Marcel, 1980) and naming latencies (McCauley et al., 1980) to target stimuli.

Table 1 presents the general pattern of results used to support the conclusion that masked stimuli for which there is no awareness may nevertheless produce differential responses. Verbal report accuracy is measured relative to chance performance, and the magnitude of semantic priming reflects the difference between the RT to targets preceded by related primes and the RT to targets preceded by unrelated, control primes. The critical aspect of the table is that while masking decreases verbal report accuracy from 100% to 0%, it has virtually no effect upon the magnitude of semantic priming. It is this *complete* dissociation between report accuracy and priming across mask conditions that provides such compelling support for the conclusion that perception may occur in the absence of awareness. Any decrease in the magnitude of priming under the mask condition would provide a skeptic with a basis for arguing that the results only show that the awareness threshold may not have been accurately determined. However, since most skeptics would expect at least some decrease in the magnitude of priming under the mask condition, it is this absence of any significant effect of a mask upon priming that provides the critical evidence.

The above arguments, coupled with the reported observations, are very seductive. However, the validity of the arguments depends entirely upon the adequacy of the procedures used to determine the thresholds

Table 1
Example of Results Assumed to Support Perception Without Awareness

	Masking Condition	
	No Mask	Mask
Semantic Priming (in Milliseconds)	40	40
Verbal Report (in Percent Correct)	100	0

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for discriminated verbal reports. These procedures, of course, provide the operational definitions for awareness (e.g., Fowler et al., 1981) or conscious processing (e.g., Marcel, 1980; McCauley et al., 1980). If these procedures are inadequate, then it would be premature to conclude that these studies provide compelling evidence for lexical access without awareness (Fowler et al., 1981), unconscious reading (Marcel, Note 2), or the extraction of meaning prior to conscious identification (McCauley et al., 1980).

A review of the Fowler et al. (1981), McCauley et al. (1980), and Marcel (Note 2) papers reveals that the thresholds for discriminated verbal reports were established by totally inadequate procedures. In all of these studies, awareness thresholds were established on the basis of a single series of trials in which the stimulus onset asynchrony (SOA) between the mask and a preceding stimulus was systematically decreased until report accuracy fell to a predetermined level. The problems inherent in this general approach are best illustrated by considering one specific implementation, and the Fowler et al. (1981) paper serves as a good example. In the two relevant studies (Experiments 5 and 6) reported by Fowler and her colleagues, the awareness threshold for masked primes was determined during a series of 40 trials that immediately preceded the experimental trials. On 20 of these threshold trials, a word preceded the mask, while on the remaining 20 trials, a blank white field was presented. The ordering for these two types of trials was random, or at least unsystematic, and the task for the subjects was to decide whether or not a word had been presented prior to the mask. Initially, the SOA between the word or blank field and the dichoptically presented patterned masking stimulus was set at 50 msec, and it was decreased whenever a subject made three or more correct responses within a block of five trials. For all but one subject in each experiment, the SOA at which presence/absence decisions approximated 50% correct was lower than the initial SOA. Thus, for most subjects, these threshold trials consisted of a sequence of decreasing SOAs with concomitant decreases in the correctness of presence/absence decisions until performance approximated 50% correct decisions.

The procedure used by Fowler et al. to define awareness implies that 50% correct report in a two-choice task necessarily represents an adequate threshold measure for discriminated verbal reports. However, 50% correct performance is an adequate threshold measure only if two conditions are met. First, it must be established that subjects actually use the two possible responses. Second, the observed response probabilities must be based upon a sufficient number of trials so that it is possible to determine if the observed stimulus-response correlations for each response differ from those expected on the basis of chance variation.

Table 2 shows examples of the ludicrous situations that can arise in a two-choice task when these conditions are not satisfied. If subjects do not actually use the two response categories and simply say "yes" or "no" every time a stimulus field is presented, the A and B distributions illustrate that they will be correct 50% of the time. It is obvious that performance in neither situation can be used to determine a threshold, since thresholds for discriminated verbal reports can be obtained only when subjects actually use more than one response. The C and D distributions, on the other hand, illustrate what may occur when response probabilities are based upon an insufficient number of observations. A comparison of these distributions shows that performance decreases from 66% correct decisions to 50% correct when only a single response changes. Given the small number of observations (six), it is clear that this rather large difference in percent correct performance is meaningless. These rather elementary examples demonstrate that 50% correct report is an adequate threshold measure for a two-choice task only when each response occurs on a sufficient number of trials to establish a reliable estimate of its probability.

Since Fowler et al. established awareness thresholds solely on the basis of percent correct performance across five trials, it is not possible to determine if their results actually provide evidence for lexical access without awareness. The observed absence of discriminated verbal reports, as indicated by 50% correct decisions, may indicate that (1) just one of the two possible responses was used on most trials, (2) the two responses were used in a discriminative manner that could not be distinguished from chance performance, or (3) the two responses were used in a nondiscriminative manner equivalent to chance performance. Fowler et al. assume that the third interpretation is the correct one and therefore conclude that the masked

Table 2
Possible Response Distributions Following Six Trials on a Two-Choice Task

	Response															
	A				B				C				D			
	Present		Absent		Present		Absent		Present		Absent		Present		Absent	
Stimulus	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N
Present	.50	3	.00	0	.00	0	.50	3	.33	2	.17	1	.33	2	.17	1
Absent	.50	3	.00	0	.00	0	.50	3	.17	1	.33	2	.33	2	.17	1

Note—*P* = *proportion of total responses; N* = *number of responses.*

primes were presented below the awareness threshold. However, since a five-trial block provides an insufficient number of observations to establish reliable estimates of the response probabilities, it is not possible to determine if, in fact, Fowler et al. interpreted their data correctly.

The above considerations indicate that there are several plausible interpretations of the Fowler et al. threshold data. Their interpretation implies that the approximately 50% correct report on the final block of five threshold trials indicates that the sensory processes initiated by the primes could not be consciously discriminated from the sensory processes initiated by the blank field. This presumed state of affairs is illustrated in Panel A of Figure 1, in which similar distributions reflecting stimulus quality are shown to occur following presentation of both primes and blank fields. However, a reasonable alternative interpretation of the Fowler et al. threshold data is that their subjects adopted a very stringent criterion for deciding, "yes," a prime word had been presented. If this alternative interpretation is correct, their subjects may have failed to demonstrate discriminative verbal behavior, even though the primes and blank fields produced discriminatively different stimulus distributions.

Given that Fowler et al. used only a single descending series of SOAs to determine awareness thresholds, the suggested alternative interpretation of their threshold data is certainly plausible. Since the threshold trials for most subjects began with an SOA that was considerably longer than the final threshold SOA, the initial distributions reflecting stimulus quality for the blank fields and the primes were probably similar to those illustrated in Panel B of Figure 1. The most appropriate criterion placement in this situation is at the midpoint between the means of the two distributions, since this would result in 100% correct decisions. As the SOA was decreased over successive blocks of trials, the prime distribution would have moved closer to the blank distribution so that the initial situation shown in B would begin to approximate the situation illustrated in C. However, if subjects did not change their response criterion when the quality of prime information decreased, "no" responses would have become more frequent than "yes" responses and percent correct performances would have approached 50%. As illustrated in Panel C, a failure to change the original response criterion could lead to an absence of discriminative responding, even though sufficient information was available for discriminated reports, if only a less conservative response criterion had been adopted.

These criticisms of the procedure used by Fowler et al. to establish awareness thresholds are also applicable to the threshold measures used by the other investigators who have claimed to demonstrate perception of masked stimuli in the absence of any ability to make discriminated verbal reports. While Marcel has yet to publish a detailed description of his methodology, in two published and related articles (Marcel, 1980; Marcel & Patterson, 1978), he refers to the method described in an unpublished manuscript (Marcel, Note 2). From the information provided in these sources, it appears that Marcel's method for establishing discriminated verbal-report thresholds is very similar to the method used by Fowler et al. He used a decreasing sequence of SOAs over an unspecified number of trials to determine what he has described as both the SOA at which subjects "could no longer make presence-absence judgements above chance" (Marcel, 1980, p. 441) and the SOA "at which subjects could not perform above 60 percent correct" (Marcel, Note 2, p. 17). In addition, in some experiments, the SOA used by Marcel during the priming trials was 5 msec lower than the one established on the threshold trials (e.g., Marcel, 1980), while in other experiments, the threshold and priming SOAs were the same (e.g., Marcel, Note 2, p. 27). No matter what the precise details of Marcel's procedures may be, his general approach for determining awareness thresholds is subject to the same criticisms that have been directed at the Fowler et al. studies. Since he does not report either the number of trials at the threshold SOAs or the response distributions at threshold, it is impossible to determine if performance on the threshold trials actually indicates an inability to make discriminated verbal reports.

The research reported by McCauley and his colleagues (McCauley et al., 1980) has the same basic methodological inadequacy found in the Fowler et al.

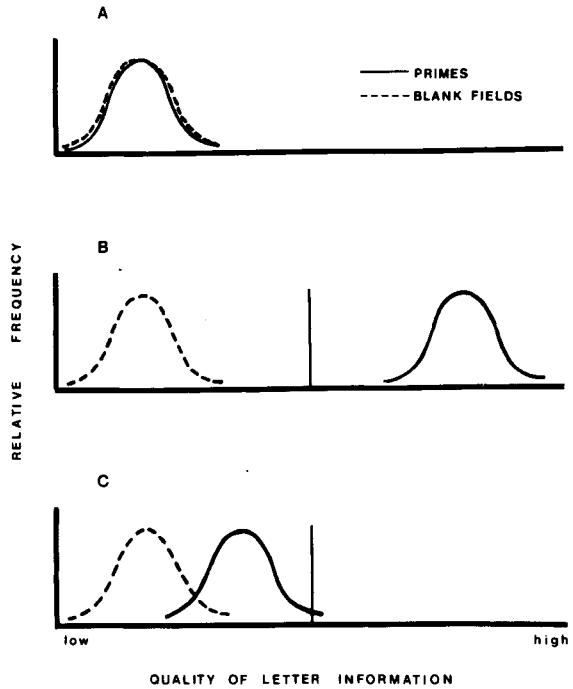

Figure 1. Possible distributions of stimulus information available for conscious processing following presentations of primes and blank fields.

and Marcel studies, even though the threshold for discriminated verbal report was defined in a somewhat different manner. McCauley et al. used 10 pictures from the Peabody Picture Vocabulary Test as priming stimuli, and thresholds for conscious identification were established by randomly presenting the pictures while systematically decreasing the picture-mask SOA from an initial 250-msec duration. For each picture, the conscious identification threshold was defined as the SOA at which a subject failed to identify the picture on six consecutive trials. Furthermore, as an added precaution, 5 msec was subtracted from each threshold SOA before the start of the experimental trials. While these procedures may appear to ensure that subjects could not consciously identify the primes, it is actually impossible to interpret the obtained threshold data. Since there were only six trials at the threshold SOAs and 10 possible responses, it is not possible to establish reliable estimates of the response distributions for each picture. As in the Fowler et al. and Marcel studies, reliable estimates of the response distributions are a necessary prerequisite for interpreting any observed patterns of stimulus-response correlations.

A final comment on the McCauley et al. study concerns their threshold criterion, defined as six consecutive failures to identify a picture. If this criterion of 0% correct identification was ever actually satisfied in a situation in which a reliable estimate of the overall response distribution was also obtained, it would indicate that subjects were capable of making discriminated identification responses. While such a response pattern would imply that, for some reason, correct responses were suppressed, it would nevertheless indicate an ability to make discriminated verbal reports. Obviously, this is not what McCauley et al. intended to demonstrate. The appropriate threshold criterion for their task would be to establish that the response probability for the correct alternative was both greater than zero and not significantly different from the value expected on the basis of chance variations in performance.

This review of the recent studies demonstrating the efficacy of masked priming stimuli suggests that these studies do not necessarily demonstrate perception without awareness. In all studies, awareness or consciousness has been defined as the ability to make discriminated verbal reports. However, as this review demonstrates, an absence of discriminated verbal reports does not necessarily imply an absence of awareness or, in other words, an inability to discriminate primes from blank fields. To establish that an absence of discriminated verbal reports actually indicates the absence of awareness, information is necessary concerning the response distributions. Unfortunately, since all studies have too few trials at the threshold SOAs to establish meaningful response distributions, none of the experiments can provide definitive evidence for or against perception without awareness. Obviously, what is needed are studies in which detection or identification performance is measured in a manner that also leads to reliable estimates of the response probabilities. Until such studies are done, the only legitimate conclusion supported by these studies of masked primes is that the efficacy of priming stimuli remains relatively constant under different levels of stimulus degradation. While this may be an interesting phenomenon, it is certainly a phenomenon that is different from unconscious perception, and it certainly does not provide evidence against Eriksen's (1960) earlier conclusion that verbal reports are as sensitive an indicator of perception as any response that has been studied.

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